THE ELECTRICAL WORLD

A Weekly Review of Current Progress in Electricity and its Practical Applications

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Electric Lighting.—XXXI.

Readers of these articles will have noticed that in last week's issue, owing to an oversight, Fig. 96 was not an illustration of the Jamin improved candle, but of the Wilde candle (Fig. 93), described in the preceding article. The correct Figure 96 is given herewith. As last issue of THE ELECTRICAL WORLD will be accessible to all interested in the articles, it is not necessary to reproduce that part of the description which related to this lamp.

THE ANDREWS CANDLE.

About the time the Debrun candle appeared, a modified form of candle was produced in England by Mr. Andrews. This (Figs. 97 and 98) resembles the Debrun candle. Its carbons remain apart and it employs precisely the same lighting device.

Instead of carbon pencils, carbon plates are used. These are about $\frac{1}{4}$ inch thick and between them, but insulated from each by small pieces of slate, is a kind of colombin, composed of plumbago in the form of a plate $\frac{1}{32}$ inch thick. Thus prepared the candle is inserted between the brass clips *b*, which hold it in place and at the same time convey the current to it. In the base of the burner is an electro-magnet *c*. The core of this electro-magnet (Fig.

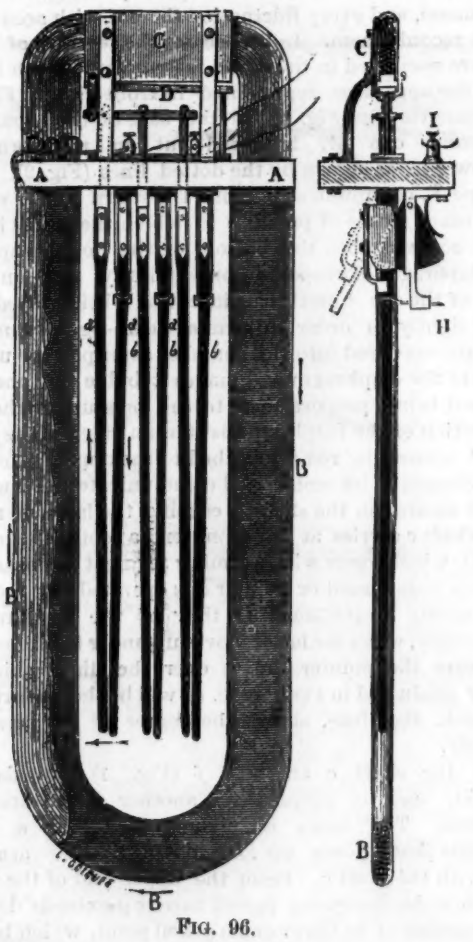


FIG. 96.

99) is divided into two pieces, one forming a part of the bell crank lever *B* carrying the carbon button *C*, which touches the candle near the base (Fig. 98) when there is no current passing in the lamp.

On admitting the current, the two pieces of the core in the coil both become magnetic with similar poles juxtaposed, and repulsion takes place, the effect of which is to tilt the lever *B* and bring the button *C* out of contact. The arc then runs up to the top, as in the Debrun candle. It moves back and forth as the carbons consume, always remaining at the highest point. With plates two inches square the candle will last about six hours. By increasing their thickness to $\frac{3}{16}$ inch and making them six inches square, they may be made to last for a whole week.

The changes of position of the arc as it moves to a higher point from a depression caused by combustion are always attended with considerable flicker, though the use of the plumbago colombin tends to mollify this disadvantage.

THE RAPIEFF CANDLE.

Mr. Rapieff, an English electrician, is the inventor of an electric candle, which does not differ very materially from the Wilde candle in its construction. In this, as in the Wilde candle, one of the carbons is stationary, the other being movable and controlled by an electro-magnet. The peculiarity of this candle is that the carbons are separated rather more at the bottom than at the top. The object of this is to maintain the circuit resistance uniform. When the

FIG. 97.

FIG. 98.

carbons are long they offer a certain definite resistance, and when they are nearly burned up this resistance disappears. This is the case in all candles where the carbons are exactly parallel with each other. In the Wilde candle the arc becomes a trifle longer as the carbons burn, and the increase of resistance of the arc compensates exactly for the diminution due to the consumption of the carbons. However plausible the idea may seem in theory, nevertheless in practice it does not appear to present any superiority over the ordinary candles having their carbons exactly parallel. The Rapieff candle has not been heard from in practice to any extent.

THE MORIN CANDLE.

Within a few months a new electric candle has been brought before the public in Paris by M. Morin, electrical engineer of the Paris Electric Lighting Company. This candle (Figs. 100 and 101) recalls at once the Wilde and the Jamin candles in the fact that it employs no colombin, and that the carbons are in contact at their tips whenever there is no current passing, and are afterwards separated by the action of the current. These results are obtained in both by the same device—making one carbon stationary and the other movable, under the influence of an armature worked by the magnetic power of the current. There is a difference just here, however. In the first two candles the armature is acted upon by an

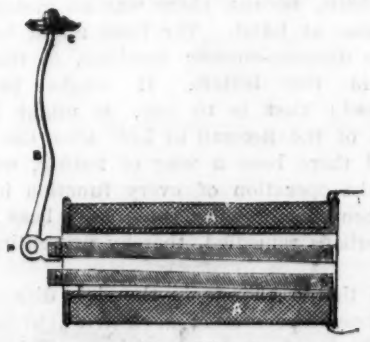


FIG. 99.

electro-magnet of soft iron. In this case the armature is acted upon by a solenoid. It is said that this simple modification makes a great improvement in the steadiness of the arc. It has been found that the unsteadiness of the arc of the Wilde and Jamin candles is due not so much to the absence of the colombin, as once supposed, as to oscillations of the movable carbons. These oscillations were the result of vibrations of the armature as it responded to every change in the magnetism of the electro-magnet controlling it. M. Morin reasoned that with solenoids the magnetic effect would not only be less rapidly communicated to an iron armature, but it would act less energetically, and thus the fluctuations would be much diminished. This merit of the solenoid when used in arc lamps has already been pointed out in connection with the Alteneck differential lamp. In the Morin lamp the oscillation above referred to is entirely obviated and the metallic vibration or clatter of the armature, which is very disagreeable in indoor installations is avoided. Fig. 100 shows a single burner. Fig. 102 is a diagram of the working parts. The arrangement recalls a galvanometer, for it consists of a flat hollow coil *S* in which a soft iron bar *A* can oscillate on a horizontal axis. Instead of giving to the solenoid coil the usual galvanometric rectangular form it is made circular in order that the wire may be brought as close as possible to the armature *A*. The carbon *C* is firmly held by its supporting clip, but the carbon *C* is held by an arm which ends in a flat spring below. This flat spring normally pushes the carbon *C* toward the carbon *C'*. The armature *A* naturally tends to place itself at right angles to the wire of the solenoid, or, in other words, to assume a vertical position under the influence of the current. Its axis carries an eccentric disc or cam *E* which forces the carbon *C* apart from *C'* when the armature moves, as will be readily understood

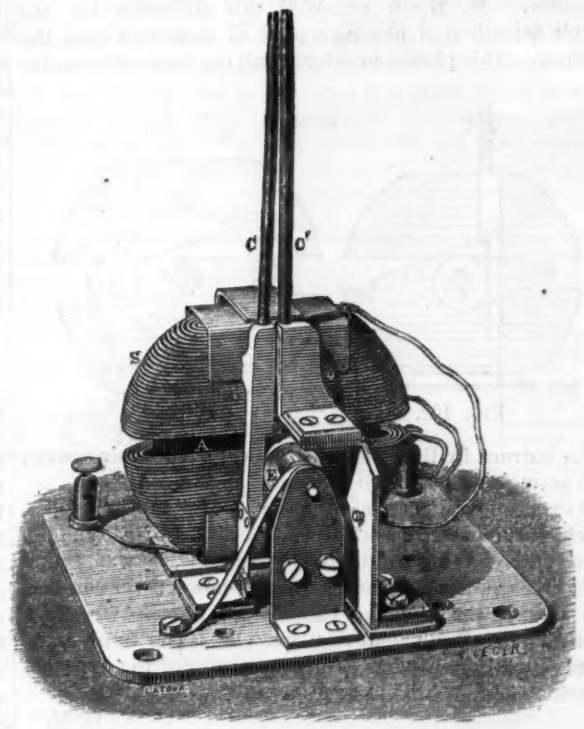


FIG. 100.

from Fig. 102. The arc then appears at the points of *C C'* and the operation of the candle is identical with that of the Wilde or Jamin candle. M. Morin has combined four candles in the same burner, all of which are operated and controlled by the same solenoid and armature, as in the Jamin burner. In this case (Fig. 101) the solenoid *S* is laid horizontally, and the armature moves on a vertical axis which carries a cam disc *E*, having four projections, *C C C C*. The carbon holders are so arranged with respect to this disc that they would come in contact successively and only one would be in contact when the current is not passing, the arrangement being exactly as in the Jamin candle. When the current is put on this set begins to burn first. Each of the stationary carbons is held in place by a small piece of zinc wire *Z*, which fuses as soon as the carbons are burned down to this point and lets the stationary carbon fall. Immediately the next set comes into contact by the return movement of the armature *A*, which instantly moves back again as soon as the circuit is established through this fresh candle. When this set is burned the next candle is brought into action in the same manner.

The phenomenon of electro-dynamic reaction which M,

Jamin utilized to keep the arc in his candles steady at the tips was observed in an interesting manner in this quadruple burner. The current in the solenoid reacted on the arc and tended to displace it, though not in all. In the two candles situated immediately above the space between the two halves of the solenoid no effect was produced, the action of one-half of the solenoid on one side of the candle evidently being

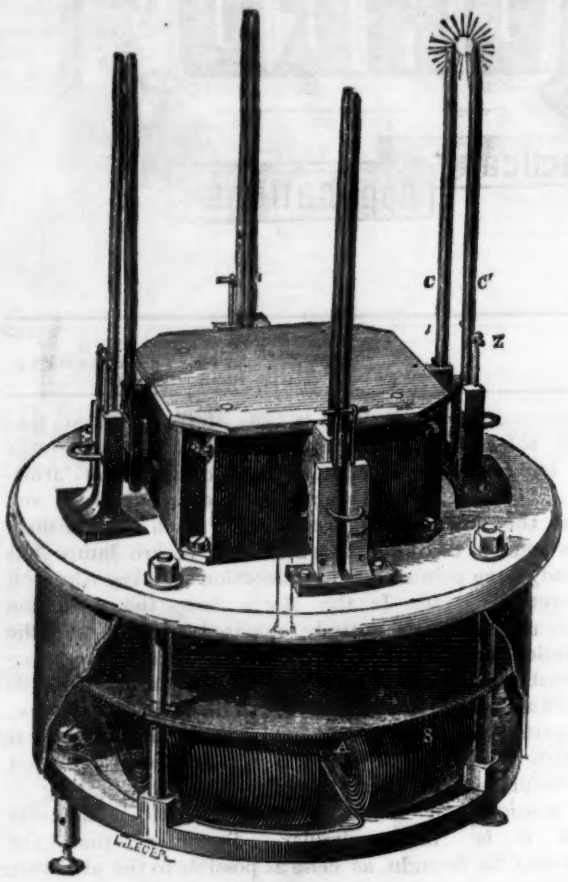


FIG. 101.

neutralized by that of the other half on the other side of it. But in that candle which is placed over each half of the solenoid the reaction was apparent. In one of them the arc was repelled upward and became arched as in the Jamin candle, while in the other it was violently attracted downward to the very base, where it played between the metallic supports of the carbons, which it would soon consume. M. Morin remedied this difficulty by the simple expedient of placing a plate of sheet-iron over the solenoid. This plate concentrated all the lines of force due

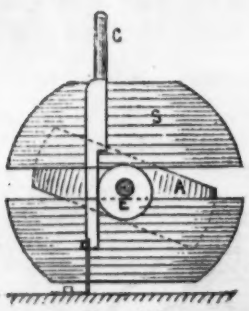


FIG. 102.

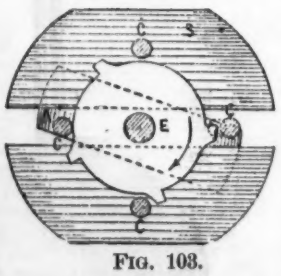


FIG. 103.

to the current in the solenoid and diverted their course, thus acting as a magnetic "screen."

In experimental tests lately made of the Morin candle, in which the power absorbed was measured by a dynamometer pulley giving continuous indications, it was found that three candles absorbed 3.30 horse-power: four candles, 4.16 horse-power, and five candles 5.40 horse-power for a lighting power equivalent to 40 carcels. The result is, of course, greatly dependent on the efficiency of the dynamo-electric machines used to generate the currents.

C. O. M.

Electrical Engineering at the Stevens Institute of Technology.

The annual catalogue of the Stevens Institute of Technology for 1883-84 is out. The following is from its Department of Applied Chemistry:

"In view of the rapid development of electrical science and the close relations existing between many of the new applications of electricity and the work of the mechanical engineer, it has been judged advisable to extend the regular course of the Institute somewhat in this direction.

"The fact that a large number of our present graduates hold prominent and responsible positions in the electrical companies throughout the country sufficiently proves that our course, as heretofore carried out, is well adapted to prepare those pursuing it for the profession of the electrical engineer, who must manifestly be first of all a Mechanical Engineer, and on this foundation build a certain amount of knowledge and experience in the special theory and practice of electric applications.

"It is believed that by the addition to our former general instruction in electric science of a special department of Applied Electricity as a part of our regular course, the actual requirements of the profession will be best met.

"The means of inaugurating this new department have been placed in the hands of the trustees by President Morton, and it is confidently believed that what may be required for its permanent establishment will be supplied in due time by those most interested in this subject.

"In this department it is intended to supplement the theoretical knowledge acquired in our previous regular course, by systematic laboratory instruction; in the management and care of batteries, galvanometers, rheostats, electrometers, condensers, etc.: in the measurement of resistances of wires, batteries, insulation resistance and capacity of cables, electromotive force, etc. These and other experiments are to be made sufficiently numerous and varied to familiarize the student with electrical terms, as potential, electromotive force, resistance, etc.; to give him a realizing sense of the various electrical magnitudes, as volts, ohm, ampère, etc., and to point out the quantitative relations of these units to the ordinary mechanical ones.

"Special attention will then be given to problems in connection with dynamo machines, such as the measurement of powerful currents, determinations of efficiency in generators and in electric motors, photometry of arc and incandescent lamps, consumption of energy in generator, conductors and lamps, dimensions of wires for various currents, etc.

"By the courtesy of electric companies, visits will also be made to examine their lighting-plant and manufactories."

The First Electric Locomotive.

Apropos of various claims for the distinction of having invented the first electric locomotive, a writer in the Baltimore *Sun* recalls the experiments of Dr. Charles Grafton Page, who was born at Salem, Mass., on January 28, 1812, and died in Washington, D. C., on May 5, 1868: "He constructed an electrical machine when only ten years of age," says the writer in the *Sun*, "and graduated at Harvard University in 1832. In 1838–40 he practiced medicine in Virginia, and in 1839–40 filled the chair of professor of chemistry in Columbia College, in the District of Columbia. In 1840 he was appointed examiner in the United States patent office, which office he held until his death. He was a frequent contributor to *Silliman's Journal*, and is the author of a concise and complete treatise upon the subject of electrical science and discovery. He had been for years perfecting machinery for the effective and economical use of electro-magnetism as a motive power, and had so far succeeded as to be able to use it for the propulsion of machinery, and as a locomotive force. In 1851 he constructed at Washington a locomotive to run by electricity, and at its first trial, on April 29, of the same year, on the Washington Branch of the Baltimore & Ohio Railroad, it more than exceeded the expectation of the inventor, though many difficulties were encountered in matters of detail. The trip was made from Washington to Bladensburg in 39 minutes, including five stops, and the greatest speed attained was at the rate of 19 miles an hour."

Edson's Speed and Pressure Recording and Alarm Gauges.

Every new industry appears to pass through a phase or period of empiricism at its beginning, and the industries which the rapidly growing science of electricity has brought forth within the last few years are no exceptions to the rule. This has been especially the case with electric lighting. We all remember the imperfect, unstudied manner in which installations for the electric light used to be made. The apparatus was constructed altogether by the rule of cut-and-try, and in putting it in operation there were symptoms of guesswork at every turn. It is not to be wondered at that so much depended on luck in those days. Just how the system would work or, indeed, whether it would work at all, were things which nobody could predict with much assurance. If the whole thing was a failure, then it was still a mystery to determine what was at fault, because there was no measuring or testing apparatus at hand. The fault might be in the lamps, in the dynamo-electric machine, in the steam engine, or in the boilers. It might be even further removed; that is to say, it might be due to the neglect of the fireman to look after the supply of steam. Had there been a way of testing, watching or recording the operation of every function involved in the work, then the difficulty could have been at once placed, and perhaps remedied, thereby preventing complete failure.

We are glad that a change in the right direction has been made in these respects and that electric light engineering can now boast of greater precision. This greater precision is due directly to a better conception and appreciation of the utility of accurate measurements of all kinds. We now have volt-meters ampère-meters, erg-meters, and improved measuring apparatus of every sort to enable us to analyze or record the operation of our electrical apparatus, and such is the importance of the facts these measurements disclose and the suggestions they present that electricians regard them as indispensable. This is a most favorable sign, for it shows that guesswork and chance occupy less prominence as factors in electrical operations.

The electrical engineer cannot confine his knowledge to electrical tests and measurements alone, however. There are other points accessory to these which often prove of greater importance. At the present time we derive our electrical energy almost altogether from coal in steam engines, and just as long as we are obliged to resort to this process it will be necessary for him to familiarize himself with the details and secrets of steam engineering.

In electric lighting steady and reliable motive power is a factor of the highest importance. Every electrical detail in an installation may have been carried out with absolute decision, and yet, if the motive power is inadequate or unsteady, failure will be inevitable. This argues very clearly that the engineer must watch over the production of the motive power, and be as conversant with everything occurring in that department as he is with the production and utilization of his electrical current.

In using steam engines, the great fundamental requirement for the production of steady power is a continuous uniform steam pressure. A bad engine may work tolerably well with a constant uniform head of steam, but even the best engine will give bad results with a steam pressure vacillating at every moment.

If we go back a step we will find that in order to get steady steam we must have a good boiler and, above all, a good, reliable fireman. We will also concede that both ought to be watched as diligently as the rest of the installation.

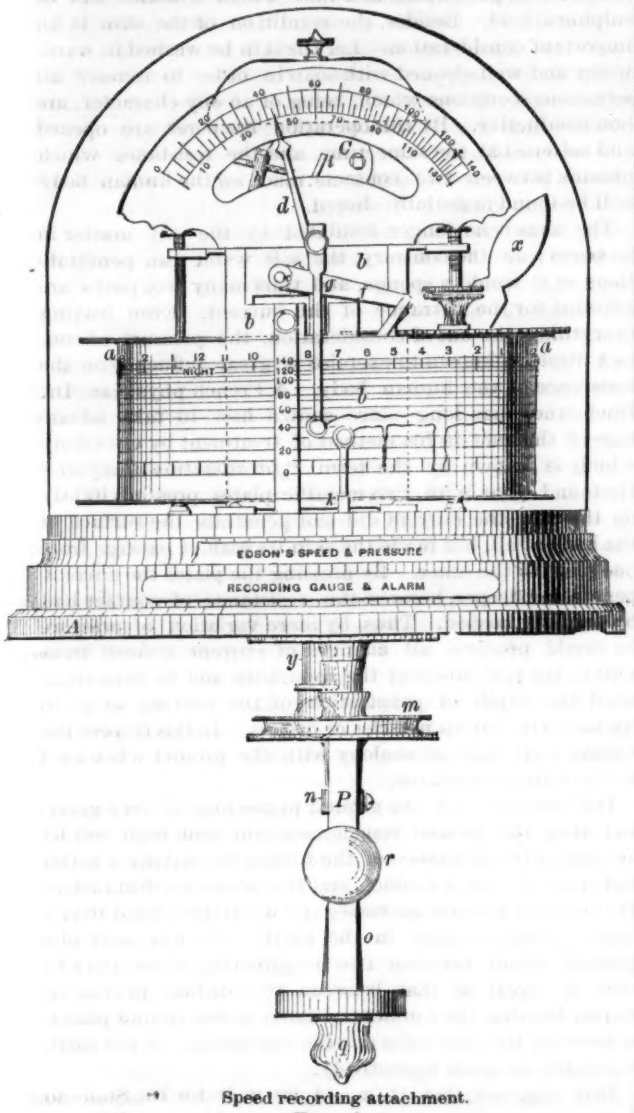
We feel certain that all engaged in electric lighting will be glad to know that they can be relieved of this responsibility and the trouble it involves by the use of an ingenious appliance invented by Mr. M. B. Edson, of New York, which assumes the whole task of "watching" over the boiler and the fireman, or even the engine and engineer, and does its work neatly as well as accurately by means of purely automatic devices. A few details of the construction of this useful apparatus, which is herewith illustrated, will show clearly the large sphere of application which makes it so desirable wherever motive power is used.

The Edson apparatus is a gauge which indicates pressures of any kind, either steam, air, or water, and which records every fluctuation or variation, and can give an alarm whenever these pass beyond proscribed limits. The apparatus may also be modified so as to become an indicator of speed, which shows at once the speed of an engine or a dynamo, and every fluctuation thereof with accuracy, while it records them. In some cases the features of both forms are combined in the same instrument. Such is the case in the apparatus represented in front view in Fig. 1, and in side view in Fig. 2. In the base of the apparatus is a round cap *A*, hollowed out in the form of a shallow cup, as shown by the dotted lines (Fig. 2). The inlet pipe *Y*, communicating with the steam boiler, water pipe or other source of pressure to which the gauge is applied, is screwed into the bottom of the hollow cap. A steel diaphragm corrugated concentrically rests on the margin of the cap *A* and forms its cover, it being fitted and packed tightly in order to form a steam-tight chamber. The steam conveyed into this chamber acts upon the under surface of the diaphragm and makes it bulge out, the displacement being proportionate to the pressure. The upward motion of the diaphragm is thus an index of the pressure. A connecting rod is attached to the upper surface of the diaphragm at its centre, and communicates its motion above to an arm on the shaft *c*, causing the latter to rock.

This shaft *c* carries at its front end a toothed segment *c* (Fig. 1), which gears with a similar segment by means of which the index hand or pointer *d* is operated, the motion being exactly proportional to that of the diaphragm. Consequently, when the latter moves up under the influence of pressure the pointer moves over the dial, which is specially graduated in every case, as will be shown further, and which, therefore, shows the degree of the pressure accurately.

From the shaft *c* an arm *f* (Fig. 1) extends to the right, and is pivoted to another arm directed downward. The latter is pivoted below to a vertical slide that moves up and down as the arm *f* moves with the shaft *c*. From the upper end of the vertical slide a slender spring pencil carrier *g* extends downward, carrying at its lower end a pencil point, which bears lightly against the paper ribbon or chart passing under it as it slides over a flat surface on the supporting frame. It is plain that as the vertical rod moves up and down the pencil point will move up and down also, and since the motion of the rod corresponds exactly to the motion of the diaphragm, the motion of the pencil will be a measure of the amount of pressure. A vertical scale placed near the pencil point is marked off in divisions corresponding to pounds pressure, ranging from 0 at the bottom to the number representing the highest capacity of the gauge at the top of the scale. In the figure this number is 140 lbs., though it varies in different instruments. The paper chart which moves constantly from left to right under the pencil point is ruled with parallel lines graduated exactly according to the subdivisions of the vertical scale of each instrument with which they coincide accurately, as shown in Fig. 1. The chart itself is moved by a special chronometer *B* (Fig. 2), which operates the vertical reel *a* by means of a worm gearing with a toothed wheel at its upper part. The gear

ing is such that the desired speed per hour is obtained. This reel winds the chart on itself as it turns and draws it from the left hand reel, which is loose. This chart has vertical divisions which correspond to the space passing under the pencil point in an hour or in a half hour, as may be preferred, these divisions being numbered. The chart is usually long enough to last thirty days, but it is marked into sections of twenty-four hours, in order that the record



Speed recording attachment.

FIG. 1.

may be removed every day if desired. As already stated, the paper will travel the space between two divisions of an hour or a half-hour during that time. If the pressure remains constant during that time, say at 50 lbs., then the trace of the pencil will be a straight line equidistant between the 40 lbs. and 60 lbs. line on the strip or chart. If, however, the pressure increases during that time the pencil trace will rise. The trace is more abrupt and vertical when the rise of temperature has taken place with rapidity. If the pressure lowers, then the trace is downward on the chart. If the pressure moves up and down in irregular succession the result will be a wavy, irregular line, as seen at *b* on the chart of Fig. 1. Since the diaphragm of the gauge can respond to every individual fluctuation of pressure with the same ease that a telephone transmitter does to air vibrations, it follows that every vibration is of necessity actually recorded by a curve on the chart. Fig. 3 shows these tracings taken from instruments in actual operation. The first shows the vibrations of steam pressure at the Colonnade Hotel. The tracing is very irregular and zig-zag, nevertheless it is seen that it does not pass below the 50 lbs. line or above the 60, and it follows that the pressure varied only between 50 and 60 lbs., except between half past four and five A. M., when it fell a little below 50 lbs. The second tracing is from the ferry boat "Hudson City," and is peculiarly interesting. Each curve corresponds to a trip made by the boat, the space from one wave to the next being equal to the time of the trip. When the boat stopped the steam pressure evidently increased about five degrees, and it fell down again during the trip. The third tracing shows the record of the water pressure at Salem, Mass., Nov. 14, 1882. From midnight to 5 A. M. the pressure remained quite constant, as shown by the nearly straight line. After five it began to decrease and to fluctuate, as shown by the zig-zag course of the tracing. The note, "Firemen filling their cisterns," is intended to be explanatory of this variation of the pressure. It is noteworthy that these charts are not all ruled alike. This is because every gauge is graduated separately. There are always slight differences in the tension of the diaphragm, and for this reason each gauge, after it is made, is graduated by itself from actual tests at all the degrees by comparison with a standard gauge. The paper charts are then ruled specially for each gauge so as to fit its graduations exactly. Where it is desirable to keep a record of the changes of speed also, the device shown beneath the base of the apparatus in Figs. 1 and 2 is used. It may be compared to the ordinary steam governor, where the valve rod moves a recording pencil in place of the valve. The pulley *m* which receives the motion, revolves on a hollow sleeve, through which the rod *l* attached to the foot piece k^1 can slip up and down. This pulley is connected to the foot-piece k^1 by flat steel springs *p*, *p*, which carry the governor balls *r*, *r*. It is evident that as the balls diverge under the influence of rotation, the rod *l* will be pushed up, and the spring pencil carrier, which is similar to that recording steam pressure at its upper end (K^1, Fig. 1), will be thrust upward to a distance exactly proportionate to the speed. The shoulder *s* and collar *n* (Fig. 2) prevent the pencil from moving up too far.

It is readily seen that this pencil point can make a tracing which will show accurately every variation of speed, and by making another vertical scale in which the divisions represent the number of revolutions the speed is indicated at once by the height of the pencil mark on the chart. By dispensing with the diaphragm and placing the speed-governing attachment in the centre of the apparatus, the rod *l* (Fig. 2.) may be connected directly with the arm on the shaft *c*, and the apparatus then becomes transformed into a speed indicator and recorder. The upward motion of the rod *l* then causes the index pointer to move. In this case the vertical scale and the dial are both graduated to revolutions instead of to pounds pressure, and thus the deflection of the index hand shows at once the number of revolutions at which the machine connected with it is turning, while the pencil carried by the vertical slide is making a record of its variations. The speed indicator might be attached to a dynamo-electric machine, and the speed at which it is running could be ascertained by glancing at the deflection of the index hand, with the same ease that the amount of current in circuit is noted by a glance at an am-meter. It remains to be seen how the gauge may be easily converted into an alarm that will warn the proper persons of danger either from excessive pressure or speed. The spindle *c* which causes the index hand to move carries an arm *i* (Fig. 2), which at a suitable stage of motion comes against the tripping post *h* of a mechanism serving to ring a bell *C*. This arm is adjusted so that it will act at the moment the index hand shows a certain pressure. As soon as that pressure is reached the lever comes in contact with the tripping-post and the bell *c* is rung by the mechanism being released. This alarm warns the fireman that something is wrong, and it continues to ring as long as the pressure remains at that height. If it is desirable, electric bell connection may be made with the engine room and other places, and the ringing of the bell there will give alarm of danger in case the fireman fails to take notice of the alarm himself. The electrical connections are extremely simple. The tripping-post *h* is insulated from the rest of the apparatus and one wire is attached to it. The other wire may be attached to any metallic portion of the apparatus. The circuit is completed whenever the lever on the shaft *c* touches the tripping-post *h* and thus the electric alarm will be sounded at the same time that the bell in the apparatus itself begins to ring. Thus if the pressure of steam increases above a certain limit the danger is immediately announced to others; and the necessary precautions may be taken by them if the fireman fails for any reason to do so himself. If he does not attend to his duty in keeping the pressure regular his neglect is disclosed to his employer, while at the same time it is recorded on the chart. The records of these variations of speed or pressure seem to have been specially useful in all cases by acting as a kind of moral check on those intrusted with the boilers or engines. Naturally, the knowledge of the fact that faithfulness or neglect is being constantly recorded is quite enough inducement to a man to do his duty. The Edson gauge, in fact, watches over the fireman and the engineer even as the watch clock does over night-watchmen; and while it is possible to tamper with the record of a watch clock, this may be successfuly kept out of the reach of any but the proper persons. Even if it were possible to reach the chart, it would be impossible to "counterfeit" the tracing, so to speak, and make it tell a lie without chance of detection.

Considered both by its mechanical perfection and its excellent results, the Edson recording and indicating ap-

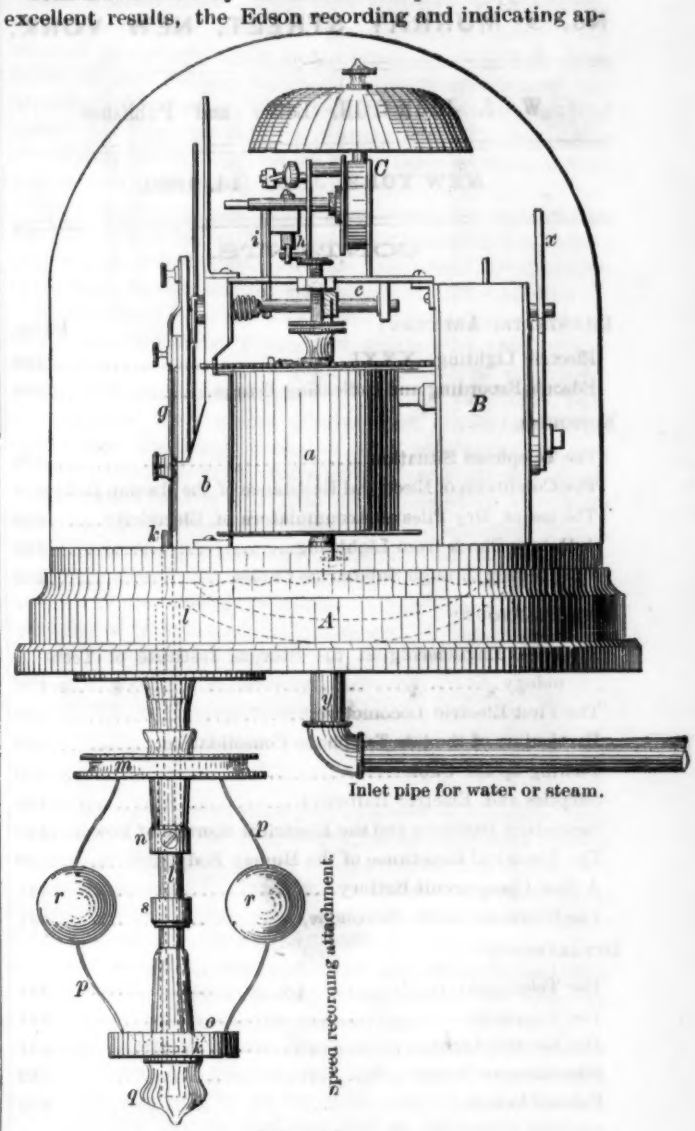
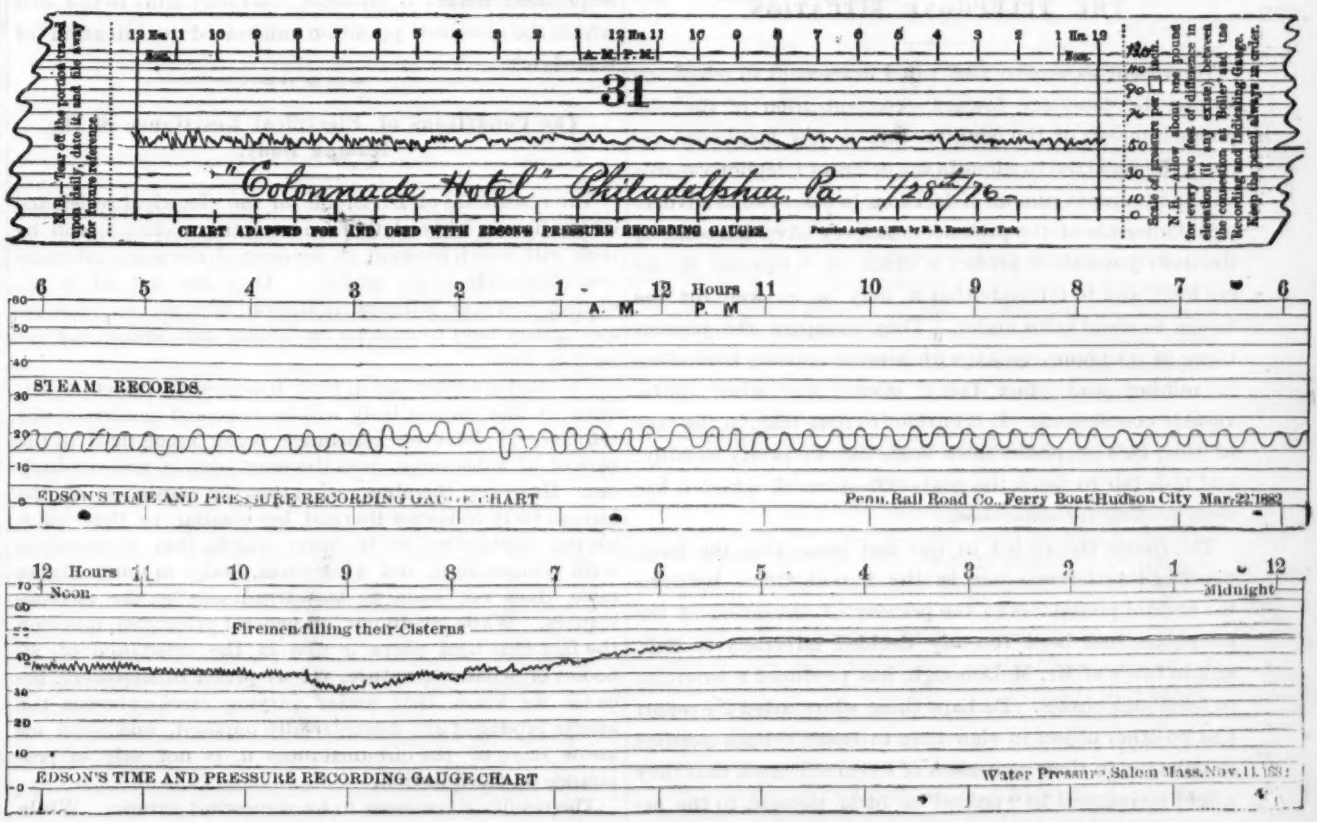


FIG. 2.

paratus is a marvel of ingenuity. Its great value wherever steam and motive power are used will be evident to all. It has already been in use for a few years in all kinds of places under every variety of conditions, and in all cases its career has been successful and has served to prove its great advantages and utility. It is not necessary to go into long details to point out the usefulness of the Edson apparatus as a means of securing greater efficiency in electric lighting. In fact, it suggests itself as being exactly what is needed to render neglect impossible and prevent irregularities which should have no excuse at any time. It has already found its place in a number of electric lighting installations, and its uniformly satisfactory operation cannot fail to render it more desirable. It is, without doubt, one of the most valuable accessories to the production of steady and economical power, and as such it should find use everywhere.

SPECIMENS OF ACTUAL "CHARTS" REDUCED.


31
"Colonnade Hotel" Philadelphia, Pa. 1/28th/76
CHART ADAPTED FOR AND USED WITH EDSON'S PRESSURE RECORDING GAUGE.
STEAM RECORDS.
EDSON'S TIME AND PRESSURE RECORDING GAUGE CHART
Penn. Rail Road Co., Ferry Boat Hudson City Mar. 22, 1882
Firemen filling their Cisterns
EDSON'S TIME AND PRESSURE RECORDING GAUGE CHART
Water Pressure, Salem Mass. Nov. 14, 1882

THE

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CONTENTS.

ILLUSTRATED ARTICLES: PAGE.

Electric Lighting—XXXI.... 435
Edson's Recording and Indicating Gauge....436

EDITORIAL:

The Telephone Situation....438
The Conditions of Electrical Resistance of the Human Body 438
The use of Dry Piles as Accumulators of Electricity....438
A Return Shock from Lightning....439
Telephoning through Submarine Cables.... 439

MISCELLANEOUS:

Electrical Engineering at the Stevens Institute of Technology....436
The First Electric Locomotive....436
Particulars of the late Telephone Consolidation.... ...439
Picking up the Cable.... 439
Skeptics and Electric Railways....439
Secondary Batteries and the Electrical Storage of Power...440
The Electrical Resistance of the Human Body....440
A New Open-circuit Battery.... 441
The Invention of the Telephone,....441

DEPARTMENTS:

The Telegraph....441
The Telephone....441
The Electric Light....441
Miscellaneous Notes....442
Patents Issued.... 442

NEW ADVERTISEMENTS.

Bergmann & Co.—New Open-Circuit Battery....443
J. W. English.—"How to Get Strong and How to Stay So"..443
United States Mutual Accident Association.—Insurance....450

THE TELEPHONE SITUATION.

The recent extensive and rapid movement in telephone stocks, the tendency toward a concentration of the telephone interests of the country into a few large corporations, the rapid fluctuations in the prices of telephone shares and the frequent rumors of decisions in patent suits adverse to the interests of the present monopoly have led some of the daily journals to predict a crash in telephone stocks ere long, and to intimate that it may be as well for the lambs to stand from under. They compare the present boom in telephone stocks with similar activity heretofore in mining and other fancy stocks, and draw unfavorable conclusions. It is curious to note that, in the face of this, Bell telephone stock holds its own pretty steadily, and bids fair to reach the goal—300—toward which it has been tending for some time.

The rumor chronicled in our last issue that the long-pending interference case in the Patent Office between the several pretenders to the priority of invention of the telephone, had been recently decided adversely to Bell, and in favor of Mr. McDonough, has produced a sensation in telephone circles. Perhaps those who started the report had no other object in view than to make certain persons so unhappy in their possession of too much stock that they might be induced to "unload" a little thereof, to the pecuniary advantage of the speculators. Tricks of this kind are not uncommon in Wall Street, and are sanctioned by numerous precedents in telegraphic and railroad stockjobbing. Meanwhile, having taken special pains to arrive at the truth in the matter, we learn that the rumor is only a rumor as yet, and an unwarrantable one at that. It is known that a decision has been rendered in the case, but everything that is reported as being the purport of the decision must be scouted as conjecture and speculation. The decision is known as yet only to the Patent Office authorities. Even Mr. McDonough himself is still unacquainted with the ominous secret which it contains. So he assures us personally. The decision is being printed, and will not be issued for some weeks. So we can calm our anxiety and hold on to our stocks a little longer.

An adverse patent decision would undoubtedly produce somewhat of a crash in Bell Telephone stocks, especially if it involved such a fundamental point as the receivers now used, without which telephony would be, if not impossible, at least very much hampered and beset with difficulties. An adverse decision would turn the tables and make it the defendant where it has always been the plaintiff; that is to say, in questions of infringement. If brought at bay by an injunction, it would be in a strait between infringement on one side and "no receiver" on the other. But only for a time. It owns the Edison receiver, the principle of which is not involved in this decision. This receiver is not convenient, and above all not reliable, and for ordinary purposes it is not practical; but it can be made to answer as a make-shift in a case of emergency until something better has been procured. In such an event the public would be the real sufferers.

Look at it as we may, any construction that can be put on the scope of an adverse decision leaves the Bell Company good enough prospects. It has the advantage of a good start. No crash can come so overpowering that it will paralyze the present occupants of the field. They represent too much capital, and their prestige is too great for them to succumb to a competitor without a protracted struggle. We do not believe that they will fare worse after an adverse decision than did the Western Union Telegraph Company under the Page patent act.

There is a rumor that a syndicate is now systematically and vigorously, though quietly, at work to secure control of all patents and inventions outside of the jurisdiction of the Bell Company, with a view to making a bold competition with that company later. We cannot say how much truth there is in the report, but it is safe to presume that the hostilities are not yet ready to begin. An opposition company would promote a disposition on the part of such servants of the public to be more considerate toward their patrons. Competition is the soul of trade, and is a wholesome check on enterprises that tend toward monopolies. However, we should dislike to see an opposition company come into the field only to play a kind of a grab game, such as opposition telegraph companies have been playing at regularly recurring intervals on the Western Union Telegraph Company. The Bell Company has already bought up a good deal of opposition, and each acquisition makes it stronger, and only adds to the evil which the so-called opposition announced its intention of remedying.

The Conditions of Electrical Resistance of the Human Body.

The researches of Dr. Stone on the electrical resistance of the human body, detailed in another column, will be read with much interest, on account of the scant information obtainable on the subject. They are not to be accepted, however, without limitation, because in some respects they tend to mislead by forcing conclusions not upheld by facts.

The doctor's supposition that temperature affects resistance in the human body will be accepted as correct, the influence of heat on resistance being recognized in the case of all substances, even the most perfect non-conductors. However, the observation that the resistance of the human body follows a thermal law similar to that influencing conductors, or in other words, that it increases with temperature, and vice versa, only in much higher ratio, does not seem to us warrantable by the circumstances. While we do not, on general principles, question the fact that heat plays a rôle in the resistance of all bodies of whatever nature, yet we prefer to stop there, because we know that under varying circumstances the effects produced are diametrically opposed, and until we know more of the circumstances it is not safe to pronounce on the question.

The results given seem to be somewhat erratic. While in the observations of June 9th the resistance should have been higher at 2:15 P. M. than at 10:30 A. M., since the temperature was also higher, it was, in fact, more than half less. It is true that the electromotive force used was double, but it will be understood that this could only increase the current, and could not affect the value of the resistance, as an ohm is still an ohm whether the electromotive force acting upon it be one volt or a thousand. It is plain, therefore, that there must have been other conditions influencing the resistance, and in our opinion one of the main, if not the most important, of the conditions is the resistance of the skin itself. All who have experimented on the human body with electricity cannot have failed to recognize the fact that the resistance of the skin itself is the great factor of the total resistance. With a perfectly dry skin, an electromotive force of 18 or 20 volts scarcely passes any current through the body. The presence of moisture makes an immense difference in the conductivity of the body, and there is even as much difference yet between pure water and that which contains salt or sulphuric acid. Besides, the condition of the skin is an important consideration. Let the skin be washed in warm water and well cleaned with soap in order to remove all sebaceous secretions which, being of an oily character, are non-conductive. By this operation the pores are opened and softened at the same time, and the resistance which obtains between two contacts made on the human body will be found materially altered.

The skin is no longer insulated by the oily matter in its pores; on the contrary, the salt water can penetrate them as it would a sponge, and thus many free paths are afforded for the entrance of the current. Even leaving everything else out of consideration, the pressure of contact itself is known to exercise a great influence on the resistance of the human body. A French physician, Dr. Duchenne, has long since shown how to take advantage of this fact in his method of treatment by electricity which is known by the term "*faradisation localisée.*" He found that with two metallic plates pressing lightly on the skin the current did not penetrate the surface of the body at all, but made the skin its path of passage from one plate to the other. By pressing the plates the current penetrated deeper, because the resistance of contact had become diminished. Thus, by mere variation of pressure he could produce all changes of current almost from zero to the full effects of the apparatus, and he thus regulated the depth of penetration of the current so as to confine it to certain muscles or organs. In this respect the human body finds an analogy with the ground when used as the return conductor.

The resistance of the ground plates may be very great, and thus the ground resistance might seem high, but let us reduce the resistance of the former by making a better and surer electrical contact, and the resistance diminishes. The current passing increases and distributes itself over a larger sectional space in the earth. The resistance of a ground circuit between two neighboring cities may be even as great as that between two distant provinces, merely because the contact resistance at the ground plates, or between the electrodes and the "epidermis" of the earth is greater, to speak figuratively.

This suggests that it would be well for Dr. Stone to determine whether or not the resistance between different parts of the same limb would be different from the resistance, say from head to foot, or from hand to hand, if the experiment were tried under exactly like conditions, so far as contact resistance is concerned.

This would show at once which is the greater factor, the resistance of the flesh of the body or the resistance of the epidermis covering it. The experiment should also be varied by trying it on different subjects, because if the skin is, as we believe, such an important item, the results must vary greatly with different individuals.

Another point which should not be kept out of sight is that there are local currents in the human body, the result of every muscular and nervous function, which correspond aptly to the earth currents in a ground circuit. A counter electromotive force may become equivalent to a certain amount of resistance under certain circumstances, and this would be a source of error. The effects of such currents may be very slight, but they are not, nevertheless, to be ignored. They show, if nothing more, that the resistance of the human body cannot be disposed of as easily as that of an inert conductor of metal.

The experiments of Dr. Stone are interesting, and it is hoped that he will persist in this line of study by multiplying his observations under more varied conditions. It would benefit the electrical public to know definitely, for one thing, what the average resistance of the human body is under definite conditions and what is the resistance of certain parts of it. Such data would be of great value to all, but especially to those who deal with undulating currents in electric lighting or elsewhere. This is a practical question which has not yet received any attention, and he who submits any new data or information concerning it will assuredly deserve the thanks of all.

The Use of Dry Piles as Accumulators of Electricity.

We read in *Wiedemann's Annalen* that MM. Elster and Geitel have made some interesting experiments on the use of dry piles as accumulators. The so-called dry pile of Zamboni is composed of pairs of round discs of paper, each covered with a metal or a metallic oxide on one side. A convenient way to make them is to punch out discs from a sheet of gilt paper and from a sheet of silvered paper. These discs are then joined in pairs with their metallic surfaces in contact, and many hundred pairs are strung on a string, after which they are pressed closely together and placed in a glass tube and provided with metallic poles or electrodes at each end. A pile of several thousand elements has a high electromotive force, but as it has an immense resistance it does not develop any appreciable volume of current. It is comparable to static electricity in its effects, owing to its high electromotive

force. It will attract pith balls, etc., just like the electricity furnished by a Holtz frictional electric machine The action of the pile depends on oxidation of the more electropositive of the two metallic substances on the discs, just as the current in a voltaic battery depends on the oxidation of zinc; but as this takes place very slowly in the dry pile, it will last for many years.

MM. Elster and Geitel have found that when the current produced by a Holtz machine is passed through a dry pile the latter acquires a counter electromotive force of polarization, like an accumulator, and this electromotive force may be quite high, in consequence of the large number of elements composing the pile. They introduced between the conductors of a Holtz machine a Zamboni dry pile of 11,000 elements and of one square centimetre section; the copper pole touched the positive conductor and the lead pole was connected with the negative pole. At the end of ten minutes the electromotive force of the pile had reached such a degree that the spark from it would leap between its poles when they were brought within one millimetre of each other in air. The pile thus polarized could operate a small Geissler tube.

MM. Elster and Geitel then conceived the idea of constructing a secondary battery with a single metal, on the plan of the Planté battery. A sheet of tissue paper dipped in a solution of silicate of potassa containing oxide of lead was pasted on each face of a sheet of lead foil. From this sheet were punched discs of one square centimetre surface which were piled together to the number of 7,000. When used like a Zamboni dry pile this Planté dry pile gave results rather more striking.

A dry pile of this kind which is polarized and then left to itself becomes spontaneously depolarized quite soon; at the end of ten minutes the loss is sensible, nevertheless, at the end of twenty-four hours the polarization can still be detected by means of a coarse electrometer.

In order to give to the silicate of potassa the necessary degree of humidity, it is sufficient to put the pile under a glass bell with a vase full of water. The authors recommend as the best method of piling the discs to string them all on a stout silk thread, and to dispense with the glass tubes.

MM. Elster and Geitel add that dry piles thus used are well adapted to showing to a large audience the principle of operation of accumulators. A Holtz frictional electrical machine replaces the dynamo-electric machine, and the effects produced in the accumulator are intense enough to be shown at a distance. If instead of forming the pile by electricity it is constructed by using the red oxide of lead, the effects produced are less satisfactory.

A Return Shock From Lightning.

On the evening of July 3, Mr. Charles W. R. Dow, manager of the Norwich (Conn.) telephone exchange, was electrically mystified in a manner that came near proving fatal to him. The thunder-storm which occurred that evening had passed away and the west was unclouded, when Mr. Dow happened to go to the sink in the kitchen to draw water. Just as he laid his hand on the iron handle of the pump he noticed a flash of lightning from the clouds rolling eastward. At the same time he received a shock that threw him senseless to the floor. It was an hour before he was able to speak, and he did not fully recover from the shock for a couple of days. There being nothing to indicate that the house was struck by lightning, the cause of the shock has remained a mystery. The phenomenon, however, admits of easy enough explanation. It was what is technically known as the "return shock." Just previous to the occurrence of a flash of lightning there is always a state of high tension both in the electricity of the cloud and in the earth immediately below. Assuming that the cloud has the higher potential, then the earth below it has the lower potential. This portion of ground acts inductively on all surrounding portions, and these all become of a *higher* potential. The ground in the neighborhood of Mr. Dow's residence was doubtless in this condition, its potential being of the same sign as the cloud, and constantly on the increase until the time of the lightning discharge. When Mr. Dow touched the metal pump he placed himself in electrical communication with the ground. He constituted a part of the ground, electrically speaking. The moment that the discharge took place at the remote point, and the potentials had become equalized there, the inductive effect of that portion of the ground on the surrounding portions ceased, and this electricity was immediately set free. As soon as set free it sought to flow to places where the potential was lower, in order that the normal condition of equilibrium might be at once reached. If Mr. Dow touched the pump and "grounded himself" just as there was electricity seeking objects of lower potential, it is plain that a small contingent of the potent agent was ready to receive him. We congratulate Mr. Dow on his escape under the circumstances, for fatal results have frequently been the consequence of such return shocks. It is said that the telephone wire leading to Mr. Dow's residence is grounded in this well. If so, we can assure Mr. Dow that his ground can be relied upon. This impromptu "test" shows that the neighborhood is all excellent "ground," but possibly he was well satisfied on this point before making the involuntary test.

Telephoning Through Submarine Cables.

An interesting experiment in cable telephony has lately been reported to us. It was made on June 10 by Messrs. Theodore N. Vail, of the American Bell Telephone Co., W. H. Eckert, J. A. Seely, both of the Metropolitan T. & T. Co., and Mr. Ladd, of San Francisco, Cal. Five submarine cables, each one mile in length, crossing the North River between New York and Jersey City, were connected together, making a total length of five miles of cable. This was placed in circuit with 106 miles of aerial wire, making a total of 111 miles. Conversation was carried on with the greatest ease, and without the least interruption from induction or retardation. In the experiment Blake transmitters, with two cells of battery for each, were used, in connection with Bell receivers.

Particulars of the Late Telephone Consolidation.

The following is the basis on which the consolidation of the Northwestern, Southwestern and Erie Telephone Companies was proposed and effected: The Erie Company has 1,500 subscribers, the Northwestern Telephone Exchange Company has 1,800 subscribers, the Southwestern Telegraph and Telephone Company has 3,000 subscribers, making a total of 6,300 subscribers. The increase of subscribers will, it is thought, be from 400 to 500 per month. These stocks were originally marketed by the so-called syndicate as follows: Erie Company, 15,000 shares, at $60—$900,000, with $75,000 cash in the treasury. Northwestern Company, 13,000 shares, at $55—$715,000, with $100,000 cash in the treasury. Southwestern Company, 20,000 shares, at $50—$1,000,000, with $100,000 cash in the treasury, making a total cost of $2,615,000, with a total amount of cash in the treasury of $275,000, leaving an actual cost to the original subscribers of $2,340,000, or an average of about $371 for each subscriber connected, being a decidedly low figure as compared with some other companies of New England and the United States. The earnings of the consolidated company upon the original price the stock was placed at by the syndicate exceeds ten per cent. Upon the dividend drawing capital to-day, namely, $4,800,000 (there being $200,000 in the treasury of unissued stock), it is five per cent., including interest on the large amount of cash in the treasury, held there for construction purposes.

The above statement was presented by the executive committee, composed of Messrs. W. A. Ingham, Charles J. Glidden and Loren N. Downs. The proposition to consolidate met with some very spirited opposition. Some of the stockholders of Northwestern were opposed to the policy of union and monopoly, Mr. Charles K. McLean, president of the First Ward National Bank of Boston, being the chief opponent of the consolidation. President Ingham favored it as an economical measure, explaining that all the contracts with the American Bell Company are limited, and, if any company is to be helped by the consolidation, it is the Northwestern, as its contract expires in four years, while the Southwestern runs to 1891, and the Erie to 1890, so that the Northwestern will get the benefit of the extension.

In response to questions on the subject in hand, Mr. Ingham still further explained. He said that it was impossible to support an exchange with only 40 or 50 subscribers. There were many such in the Southwest, and in order to make them profitable it was necessary to connect them with each other and with large places. This involved, of course, considerable expense for extra territorial lines. In the Northwest the state of things was similar, though not identical, as the principal business is in the two cities of St. Paul and Minneapolis. Now, the Erie property is exceedingly valuable. He would as soon have the city of Cleveland as Boston, and the Lowell syndicate stands ready to pay $1,500,000 cash for Boston, while Cleveland represents only $825,000. He expected that Cleveland would reach 3,500 subscribers. The average from each at present is $84 a year, which leaves a large net income. Mr. Ingham repeated that the greatest care had been given to this matter, and nothing had been proposed without the most serious consideration. When the company is consolidated, it will be the largest telephone organization in the world. Another point for Northwestern stockholders to consider is that the Erie and Southwestern folks get better rates from the American Bell, which is a considerable item in the course of a year.

In regard to a renewal of the Bell contracts, Mr. Ingham said that point had not yet been broached, and then went on to explain the relation of these companies with the American Bell. The exchanges agree to use the Bell telephone and pay a certain annual rental, and the Bell people agree to defend and protect the patents which cover it. If the Bell patents should fail, of course that would end the contracts, and exchanges would no longer be obliged to pay. "But," said Mr. Ingham, "if I was as certain of going to heaven as I am that the American Bell can successfully defend its patents, perhaps I shouldn't go to church so often. There have been," he continued, "a good many paragraphs in the papers tending to depreciate the value of the telephone properties, and very absurd statements in regard to them. It was charged that people in Lowell were mortgaging their houses to buy stock which was only worth a tenth of the money asked for it. Now, as a matter of fact, everything connected with the telephone, except the bare transmitter and receiver, had to be provided by the exchange, and, so far from the plant being inexpensive, it was a fact that the telephone system of Cleveland could not be duplicated for $300,000."

Mr. McLean didn't think the proposed consolidation equitable. In the course of his remarks he said: "The want of public confidence in the syndicate at Lowell is the cause of the decline in the telephone stock. It has depressed its value, and it is, therefore, about time to stop watering. The consolidation is unnatural. The territories are widely separated, and to bring them together in this way cannot be justified."

The whole number of shares voted on was 9,982. Against consolidation, 841 votes; for consolidation, 9,141; majority in favor, 8,300. Besides this, over 500 votes in favor were thrown out for various slight informalities.

A meeting of the directors of the Erie Company and the Southwestern Company was held, and it was voted unanimously to consolidate, the requisite number of stockholders in both companies required by law to consolidate having signified their assent thereto. In accordance with this action the stock books of the Southwestern and Northwestern companies were closed, and all the stock will be called in and the Erie stock issued in exchange therefor. In spite of the cheerful feeling manifested by a majority of the stockholders in attendance, it was clear that some uneasiness is felt as the time approaches for the decision of the question whether Bell or Drawbaugh was the original inventor of the telephone. If the case should happen to be decided in favor of the Drawbaugh claimants, a lively panic is predicted.

Picking Up the Cable.

The laying of telegraphic cables is now so common that the description of the machinery for picking up a broken one will be read with interest. It consists of a rope about an inch and a quarter in diameter, made from the strongest hemp, with interwoven wires of fine steel. The grapnel at the end is merely a solid shaft of iron some two feet long, and weighing about one hundred pounds, and prolonged into six blunt hooks, which much resemble the partly-closed fingers of the human hand. In picking up the cable in deep water the Minia, after reaching the waters near the break, lets out her rope and grapnel, then takes a course at right angles to the cable and at some distance from the fracture, so that the broken ends may not slip through the grapnel. The grapnel rope is attached to a dynamometer, which exactly measures the strain on the rope, and shows unerringly when the cable has been caught. If the grapnel fouls a rock the strain rises very suddenly to a high point; but the exact weight of the cable being known, the dynamometer signals by the steady rate of increase its hold on the cable far below. The ease and certainty with which cables are picked up in these days are amazing. A while ago one of the lines of the Anglo-American Company was caught without trouble at a depth of two and a quarter miles near the middle of the Atlantic. Captain Trott, of the Minia, who has won great fame for his skill and ingenuity in cable matters, but recently picked up the French cable 180 miles off St. Pierre, and in four hours from the time the grapnel was let go had the cable spliced and in working condition. The splicing is a work of great delicacy and skill, and when accomplished by trained fingers the spliced part can scarcely be distinguished from the main cord. So rapid has been the improvement in perfecting the modern cable, that the resistance to the electric current has been reduced to one-quarter what it was twenty years ago, while the duplex system of sending and receiving messages doubles the capacity of every new cable laid.—*Age of Steel.*

Skeptics and Electric Railways.

There are always croakers to predict the failure of every invention under the sun; but the number who make the electric railway the subject of doleful prophecy is extraordinarily large. The *Mail and Express* of this city gives them the following pointers:

The foremost electricians do not predict that electricity will immediately supersede steam as the motive power for the railways of the country, but they do assert that its introduction on the elevated railways of New York and on such short lines as those which run to Coney Island is likely to be soon effected. There are some skeptics who say that because electric motors are not already in use the inventors have failed to solve the problem undertaken by them. Let these skeptical persons remember their predictions that the electric light would never be introduced to common use, and yet its progress has been steady in all parts of the world. Mr. Edison's success in the down-town district which he now illuminates in New York is unmistakable, and there is no room to doubt that nearly the whole city will be illuminated by electricity almost exclusively within a few years. There has been much progress in the adaptation of electricity for use on railways, and the construction of a tunnel under the Thames in London, for a railway to use electric motive power, is an example to show what is being done. The skeptics may expect to see electricity take the place of steam on the elevated railways of our city within a very few years.

Secondary Batteries and the Electrical Storage of Power.

An abstract of the first lecture by Prof. Oliver J. Lodge, on the above subject, was given in THE ELECTRICAL WORLD of June 30th. In his second lecture, which was delivered before the Society of Arts, London, May 28, Professor Lodge said there were one or two further experiments with the little battery before him (with which he had experimented on the occasion of his previous lecture) with which he should begin, because they really threw a good deal of light on the action of the secondary battery. He wanted to show the extreme value of peroxide of lead on the positive lead plate. For instance, let them take a piece of clean platinum and put it into the cell instead of the negative lead plate; they had platinum on the one side, and peroxide of lead on the other, both highly electro-negative substances (experimenting). That amount of current was given by platinum opposed to the peroxide of lead, the platinum acted as zinc compared with peroxide of lead. Putting in a piece of clean copper as the negative plate they got a current which lasted longer and which was able to ring a bell. The copper plate, in fact, gave very considerable power and lasted fairly well. The copper was dissolved and formed sulphate of copper. The action of the battery was over when either the copper was dissolved or when the sulphuric acid was consumed and turned into sulphate of copper. Instead of copper he would now take a piece of lead which they would imagine to be still better than copper. He put the lead in the acid; he tried it with the current and the current was immediately over. The plate seemed done for, and why? Because the clean lead plate had got into such a state that it would give a current neither with peroxide nor with hydrogen, neither with zinc nor with platinum; it was, in fact, almost as if it were a piece of wood, it was coated with an insulating film. If he put in a piece of spongy lead the current would go on for a long time, so that by giving the lead a large surface, by making it spongy as might be done mechanically, chemically, or electrically, they got the negative surface so large that no scum formed on it for a long time. It was owing to the smooth and limited surface of the clean lead that the scum formed almost instantly. It was, of course, however, a question of degree. Another point he wished to call their attention to was the great advantage which the inactivity of lead after the first instant conferred as a support for the peroxide. If he took a piece of clean lead and opposed it to the peroxide plate, it refused to give a current after the first instant. The insolubility of sulphate of lead, which to some extent was a trouble, was, however, to some extent a gain. The plates of which a battery was made might be spongy, or might be perforated, or might be folded. After describing how these leads were made the lecturer went on to consider the subject of metres. The means of measuring the current, he said, was nothing else than measurements made in either putting into the cell or taking out of the cell—in charging or discharging. There were metres for the measurement of current, of electro-motive force, of quantity, of power, and of energy. The two first he would take as fundamental. Then quantity was current multiplied by time, current multiplied by electro-motive force was power, and energy was quantity multiplied by electro-motive force or power multiplied by time. He would not say anything about current measurers. Any low resistance galvanometer would act as a metre for current, and any high resistance galvanometer would act as a measurer of electro-motive force. To measure the current of electricity the most direct and the simplest way, in some respects, was by some such arrangement as this (showing model). He had found the instrument, of which that was a model, exceedingly valuable. It consisted of a balance suspending a copper cylinder in a vessel of copper lined by a much larger copper cylinder. He should totally immerse it in the liquid, but no more, and now he would put the current on, so that the outer plate was positive and the inner negative. The inner plate would receive a deposit of copper, and as it did it would get heavier and the balance would sink, and they should find the plate at the bottom of the cell before very long. Hence it enabled them to say how much was in the cell, because whatever had gone in had deposited copper, and whatever had come out had removed copper. Of measures of energy or quantity multiplied by electro-motive force or power there were several. Mr. Boys, he believed, had several, but not in a state of perfection. Ayrton and Perry had also their recently constructed power metre, which was very simple, and might very likely give very good results. Having previously discussed the charging and discharging of the cells, they had now to consider how to use the discharge. The first and most obvious use was lighting. The advantages of secondary battery purposes for lighting were found when the lighting was in a traveling conveyance—in a train or a ship, though in a big ship, with so much engine-power on board, they might run from the dynamo direct. But supposing they wanted to light a cab, they might carry a box with them sufficient to keep a small lamp lit. And the use of the battery for stationary installations was when they wanted a greater power than their engine would give. That especially applied to cases where they used steam-engines. It did not pay them to let an engine lie idle all day and have it working at night only; it was better to have it running regularly. And when they wanted to use the light, having stored it up in secondary batteries, they could run it off at a high rate of speed and thus increase the power of the steam-engine, compressing its total energy into smaller compass, and at the same time they gained in security, because the batteries once charged were not quite so liable to break down as a belt was to slip. A third advantage of the secondary battery was the steadiness with which it produced the light. (The lecturer here showed this by the lighting of several Swan lamps and also a Pilsen arc lamp in the hall.) There was nothing new in the lamps, but they shone with absolute steadiness, there being not a sign of fluctuation about them. That resulted from lighting from the battery direct. They might put out any of the lamps without interfering with the others, and that was not so easily done with dynamos. One great use of storage batteries, which was pointed out by Sir William Thomson at the British Association meeting at York, was to have them act as receivers in the transmission of energy. The theory of the economical transmission of energy was worked out practically by Dr. Siemens a few years ago. He pointed out that for economy they must have as high electro-motive force as possible. A set of batteries as a receiver was far more economical than a set of dynamos. An economical force from a dynamo could only be obtained by running it at an enormous speed. There was a certain limit, however, to that speed, and if they wanted an excessive electro-motive force they must have a fair internal resistance. The more suitable machines were those which gave a high electro-motive force. Then they came to the driving of motors by the secondary battery. It would be found an advantage when the secondary battery received the power from a distant station. A motor was the same as a dynamo, except that the field magnet in a dynamo was much smaller and more compact. There was no limit to the size of the field magnet, but there was to its weight. The reason why the Edison machine was such a good machine was because the magnet was so gigantic. If they considered the action of a magnet when it was excited, they would perceive that all the current was doing was to generate heat. There was a remarkable analogy between the production of magnetism in iron and the muscular exertion of an animal. To raise the magnet to its highest power required work, and to keep it there required work. It would be a great advantage if the iron would keep the magnetism. Profs. Ayrton and Perry had lent him a motor (exhibiting motor), and the peculiarity of that instrument was that the field magnets revolve instead of the armature (experimenting). Motors were by no means perfect at present; there would be an immense development in them yet. Coming now to locomotion. If they were to have a railway driven by such means the simplest plan would be to attach a motor to each wheel of the carriages; they would then be independent of an engine. In that case he thought it would be more convenient to have a carriage run from a station every minute than a train every five minutes. He did not say the running of a carriage every minute would suit the underground railway, considering there were so many trains there already; but there would be an enormous advantage in having the trains run there by means of electricity, and it seemed to him absurd to put coal-burning locomotives on the underground railways, when this system could be readily adopted. The dynamo, again, was so exceedingly well suited to a small screw boat that he could not help thinking that there was a great future for the dynamo in marine propulsion. The weight of the dynamos for big ships would be too heavy, but he doubted not that some means would be found to make them lighter. For a central station, however, the weight of the battery boxes was of no consequence. The practical development of electrical appliances in the near future he felt would probably be something extraordinary, and he only hoped they would have as great a social influence as they would have a mechanical. He also trusted that the result would be the abolition of smoke and the purification of the air. A greater benefit to society than that he, for one, was unable to imagine.

The Electrical Resistance of the Human Body.

There is but little known concerning the electrical resistance of the human body and the conditions by which it is influenced. The following note by Dr. W. H. Stone, which we find in *Nature*, will be interesting as a contribution to our knowledge of the subject:

The experiments which I have now for some years been carrying out as to the various forms of medical electricity have begun to furnish trustworthy results. Some of these, with the help of Dr. Kilner, were incorporated in a paper read before the Society of Telegraph Engineers on March 9, 1882. We there stated that at present "we are hardly in a position to say how far the resistance of the body varies in health; but in disease it can be fairly stated that it sometimes diminishes and sometimes augments." Of this fact we gave illustrations.

It had often occurred to me that the temperature of the human body very probably influences its resistance; and some experiments had been made with a view of testing the amount of such influence. But in pathological researches it is often difficult to find a case not open to exception, and it is frequently necessary to wait a considerable time before, in the impossibility of experiment, accident presents one possessing the necessary conditions. Such a case I have now met with, and it is worth while to place it on record, if only to enable other observers to prosecute this line of investigation.

The patient is an intelligent gunsmith, aged twenty-two. He had rheumatic fever severely twelve years ago, which, as is usual in young subjects, has left permanent heart disease behind it. This did not, however, prevent his following his trade until the beginning of April in the present year. He then began to suffer from morning rigors, occurring at first at intervals of from seven to ten days, but, since Easter, daily. He came into my ward in St. Thomas' Hospital on April 28. It is not necessary to detail the medical history of the case in a scientific periodical; it will be sufficient to state that about 8:30 A. M. he was in the habit of suffering from severe attacks not unlike those of ague, in the course of which the temperature rapidly rose to 105° F. In the afternoon it sank to the normal human temperature of 98° or 99° F. The cause of this remarkable symptom is still somewhat obscure; it has completely resisted the action of quinine and other antiperiodics, as well as salicylic acid, aconite and other approved lowerers of temperature. It is probably due to ulcerative endocarditis slowly advancing. The most remarkable part of the case is that it causes the patient no suffering or inconvenience whatever. His mind is clear, and, except the feeling of chilliness during the period of heat, he makes no complaint. He is able to take interest in the determinations which I proceed to give.

It occurred to me that this unusual range of daily temperature (7 F.) afforded the opportunity I had long been seeking. But it was some time before I could arrange suitable apparatus for its examination. A hospital ward is an awkward place for Wheatstone's bridge and delicate galvanometers. Moreover I had before found that from the peculiar conditions of the human body, the testing current, to produce accurate results, requires to be frequently reversed, for fear of opposition currents of polarization. I am glad to see a confirmation of this observation in a verbal communication of Prof. Rosenthal to the Physiological Society of Berlin on April 13.

It was partly to overcome this difficulty that I devised, at Mr. Preece's suggestion, a dynamometer for alternating currents, of which the general arrangement was described in *Nature* some time ago. It was also brought before the Physical Society at their June meeting in Oxford. Although severely criticised by some members of that learned body, it works extremely well, and may be, I hope, an addition to medico-electrical appliances. For the purpose of the present experiment I found that an ordinarily sensitive galvanometer, considerably damped by air resistance, was sufficient, since by the zero methods of balancing, it is only necessary just to see the deflection before commutating; when balance is obtained, commutation has no effect on the needle of the bridge.

It would require more space than could probably be here afforded to give all details of the experiments, which, moreover, by the courtesy of Captain Douglas Galton, I hope to bring before the British Association of this autumn. But a brief summary of results is as follows:

On June 5 I reached the ward at 9:40 A. M. The rigor had begun at 8:30, and was beginning to decline; I had time, however, for the following determinations:

9:40	R. 4,140 ohms.
9:55	" 3,470 "
10:10	" 2,900 "

These measurements were taken with a very small E. M. F. of about 9 volts. On June 9 I succeeded in reaching the ward during the beginning of the rigor, and took the following measurements, this time with corresponding temperatures:

10:30 A. M.	Temp. 102°.4	R. 4,550
10:40 "	" 104°.4	" 4,630
10:50 "	" 104°.2	" 4,930

At this point the rigor, temperature and resistance began to descend. I visited the patient again at

2:15 P. M.	Temp. 103°	R. 2,300

The apparatus in these observations was left untouched, so as to prevent any accidental change. The measurement was made with a double E. M. F. to those preceding, namely, 18 volts. I determined on each occasion the resistance of the leads and terminals, which I found to be on each occasion 2 ohms.

I cannot help thinking that the difference, which is as nearly as possible twice the smaller amount, is too great to be accounted for by any instrumental error, and that the human body, in spite of its large amount of liquid constituents, follows a similar thermal law of resistance to that influencing solid conductors, though in a very much higher ratio.

Only one other point requires comment, namely, the mode of making contact between the body and the testing apparatus. Prof. Rosenthal, in the communication quoted above, draws attention to the high insulating powers of the epidermis. In the above experiment I passed the current through the two legs, from one foot to the other, in alternate directions. The feet were previously soaked in salt and water; two large pans containing about a quart of brine each were then placed under the feet, and in each was immersed a plate of copper five inches square connected with the bridge by stout cables. I have found in other experiments that after half

an hour the resistance ceases to decrease, and in this experiment it is actually increased to the amount of 480 ohms. The whole foot was immersed, its sole resting directly on the copper plate. I have two other methods of making contact in use. The first consists of rubbing the skin with the oleate of mercury; which to the diffusive power of oleic acid adds the conductivity of its base, and then immersing the part in metallic mercury. The other consists of inserting small silver claw-forceps, known to surgeons as "serrefines," through the epidermis into the tissue below. This is rather painful, but not more so than I find medical students eager in the pursuit of knowledge can and will easily undergo.

A New Open Circuit Battery.

The Leclanché battery continues to retain the favor which its excellent merits and its applicability to open circuit work have gained for it in a career of over ten years. It still remains the favorite, to the disparagement of the many rivals which have sought to supersede it. But, however useful this battery is, it is somewhat lacking in the requirement of cleanliness, and this debars it from many an application where it would otherwise be desirable. We have often wondered why some inventor did not come to the front with an improvement for this defect. We used to think that the problem was a little complicated and beyond the possibility of solution within the limits of economy, but we candidly acknowledge our mistake. Messrs. Bergman & Co. have sent us a specimen of their new open-circuit cell which answers the question in the most satisfactory manner imaginable. It contains the same elements as the Leclanché cell, but is so much neater and more compact that it is in reality a new cell. It is of very small size, being only 6½ by 3¼ inches and of convenient form. The jar is cylindrical and straight, and a zinc cover screws over its neck like the covers of fruit jars. The upper portion of the cover is made of acid and waterproof cloth. The cover fits hermetically close and the jar is, therefore, watertight. The electrodes pass through the opening in the cap, and are disposed neatly and symmetrically, adding greatly to the appearance of the battery, which is so neat and presentable that it will at once recommend itself for all indoor uses, the telephone particularly. It gives off no gases, does not lose water by evaporation, and, it is said, will last much longer without becoming exhausted than the ordinary Leclanché battery. Besides all these merits, it possesses the great advantage of cheapness. It is sold at a lower price than the common Leclanché, and this will be of itself a good recommendation for it.

A New Enemy of the Telephone.

A delegation of telephone subscribers from the Eighteenth ward called at the office of Superintendent McKinstry yesterday afternoon, says the Cleveland *Herald*, and complained that some new wire that had been strung along through that ward was interfering with the workings of their telephones, at times rendering them perfectly useless. The wire was discovered to be that of the Postal Telegraph Company. On Harvard street, east of Broadway, and on the Bedford road, the Postal line runs within eight or ten feet of the telephone line for a distance of three or four poles, and although an ordinary wire at the distance would produce no effect whatever, the system of telegraph in use by the Postal Company renders the telephone line almost of no value. The sound produced by the enormous induction from one heavy copper wire of the Postal wire is much like that of a fish-horn. While the Leggo system of telegraph, which has already been described in these columns was used over the new company's wire, some trouble was anticipated in the working of the telephone, but it was not thought a material difficulty. Afterward, however, the Gray harmonic system, which the *Herald* has also described, was put in use on the line, and the induction was so great that much complaint began coming in. At first the owners could not imagine what was the difficulty, and even electricians did not believe it possible that wires so far distant could produce the effect. It appears, however that the system now in use over the line is particularly conducive to heavy induction, and the wires will be raised still farther away from the telephone line.

Mr. McKinstry appeared before the Board of Improvements last night and asked for permission to have the wire changed, which was granted him.

The Invention of the Telephone.

To the Editor of The Electrical World:

SIR: With due regard for the genius of Mr. Reis, and believing that his labors have hardly received their full recognition, I think Professor Thompson steps beyond reasonable probability in claiming for him the principle of undulatory currents.

I do not now discuss the question as to whether Reis at any time actually transmitted them, but whether he was aware that they were necessary to the successful transmission of articulation.

To prove this it will be necessary not only to show his knowledge of the fact that a contact varies its resistance by variation of pressure, but also that he tried different substances for the accomplishment of this all-important result.

The records show, however, that he used platinum, which alone is one of the conductors least adapted to show difference of resistance at a contact; and, besides, Reis never dwells on the existence of a contact resistance.

The apparent contradiction which Professor Thompson lays stress upon, that Reis explained the true nature of sound waves, and yet makes use of the word "interrupter," simply shows that while he had a fairly accurate knowledge of the different sound curves he believed they might be translated into electric curves by a system of break and make of contact.

Any telephone experimenter can testify to the difficulty of getting anything beyond a simple musical sound when experimenting with apparatus identical with the Reis; and although by means of the sensitive bell telephone we can trace the occasional existence of undulations, it requires even then skillful manipulation and a trained ear. On the other hand, it is only by means of transmitters built on the present knowledge of the art that we can successfully make a Reis receiver talk.

Here I beg to call attention to the remarkable inconsistency of a statement by Reis, to wit: "The consonants are, for the most part, tolerably distinctly reproduced, but the vowels not yet to any equal degree."

Now, with the exception of the "s" and "r" sounds, it is difficult to pronounce and more so to transmit (with a Reis transmitter) a distinct or an indistinct consonant without the co-pronunciation of a vowel, and, moreover, it is at present just the reverse, because vowels can be easily transmitted, while with the best transmitters consonants come often indistinct, notably the "s," pronounced by itself. Will Professor Thompson kindly point out a reason why this should not greatly weaken the accuracy of Mr. Reis' statements?

It is more than probable that Reis found the same difficulty in transmitting by break and make of contact and, even granting for a moment that he entertained the idea of transmitting without breaking contact, he found it so discouraging that he abandoned the thought and tried to improve his "interrupter."

There remains the possibility of transmission by an "arc," but would as acute a mind as his ever have stopped at platinum and not tried carbon, if the thought of transmitting a continuous vibratory current by means of an arc had occurred to him?

Let us have all the light attainable on Mr. Reis's ever-memorable experiments, but so long as the proofs rest on the construction of doubtful words and sentences, and unless Mr. Reis can be credited with having been aware of the phenomenon of contact resistance and its variation by pressure, his fame must rest where Mr. Bell's begins.

BOSTON, July 5, 1883. E. BERLINER.

THE TELEGRAPH.

LIFE OF TELEGRAPH POLES.—The durability of telegraph poles is stated by an expert to be as follows: Cedar, sixteen years; chestnut, thirteen; juniper, thirteen; spruce, seven. Cedar, chestnut and spruce are used in the Northern States, juniper and cypress in the Southern States and redwood in California. Poles cut in the summer will not last as long as those cut in the winter by five years. Soil and climate, of course, make a difference with the lives of the poles.

SUNDAY SERVICE TO BE PAID FOR.—The Western Union Company, which in many offices did not pay for Sunday work, causing dissatisfaction among the operators, has promulgated an order that hereafter a day's work will consist of nine hours a day six days in the week, or seven hours a night seven nights in the week. All service in excess of this is to be paid for at regular salary, on the basis of seven hours to a day.

UNDERGROUND TELEGRAPHING.—On the 10th, articles were filed incorporating the New York Underground Telegraph Company, with a capital of $50,000, divided into 500 shares. The intention is to run wires under the streets of cities and towns in New York State. Joseph C. Herr, Robert D. Radcliffe, William S. Cooper, George R. Thompson, Thomas P. Simpson, H. S. Beattie, Charles Dickenson, William S. Taylor, William H. Johnston, William A. Hangerford, George McGowan, Joseph E. Ecclesine, A. F. Sabine, John Matthews, Sextus S. Smith, Luther G. Tillotson and William H. Mervell are the incorporators.

THE AMERICAN RAPID.—It is rumored that the American Rapid Telegraph Company is to be leased to the Western Union, the latter company guaranteeing a 3½ per cent. annual interest on the $3,000,000 capital of the Rapid Company. The Executive Committee of the Western Union Company had the matter under discussion at its last meeting, on Wednesday, July 11, but nothing definite was arrived at. The hitch seems to be that the Western Union is unwilling to assume the obligations of the Rapid Company. That company is said to have now more than 14,000 miles of completed wire.

JUDGES DISAGREE AS TO THE WESTERN UNION CASE IN ILLINOIS.—At Chicago on the 6th the question of jurisdiction between Judges Gary and Blodgett arose again when the motion was reviewed before Judge Gary in the quo warranto case of the people ex rel. A. C. Story and others against the officers of the Western Union Telegraph Company for a stay of proceedings, and to have the case stricken from the docket. The motion was made by Gen. Thompson on behalf of the telegraph company on the ground that Judge Blodgett, by express order, had already assumed jurisdiction of the case. A certified copy of the order was produced and read. After a running fire of argument the Judge said he wanted some authorities on the point that the Circuit Court of the United States had a right to overrule a Circuit Court of the State of Illinois. He had decided that the case was not removable; Judge Blodgett had decided that it was. There was an open conflict of jurisdiction. Both courts were inferior courts and had similar jurisdiction and powers. He admitted that the Federal court could issue a process to enforce its orders, but declared that until it did so he would stand to his former ruling and retain jurisdiction. Gen. Thompson said he did not want to push the matter so far, for he thought the Judge of the State court would yield to the law when he found the Federal court had assumed jurisdiction. Judge Gary reiterated his determination to keep control of the case until some process of the Federal court was issued against him, and overruled the motion for a stay of proceedings. He held that the United States Court was mistaken about the removability of the cases, and while he would obey its writ he wouldn't obey its mistake. This produces a direct conflict of jurisdiction between the two judges, and there are prospects of lively times ahead.

THE TELEPHONE.

INDIANA.—A telephone line is being constructed to connect New Castle and Cambridge City.

POLE TAX.—The City Councils of Erie, Pa., have decided to levy upon telephone companies a tax of two dollars for each pole. There are three hundred poles in the city.

MEXICAN TELEPHONE COMPANY.—The meeting of stockholders to vote on the increase of stock will be held in New York, as required by law, about the middle of August.

ANOTHER TELEPHONE COMPANY IN THE KEYSTONE STATE.—A new telephone company has been formed in Perry County, Pa. A telephone line will be run from the principal towns to New Bloomfield.

THE LOWELL COMPANIES.—A special meeting of the various telephone companies under the Lowell management was held July 11. The quarterly dividends are as follows: Bell National and Maine, 1¼; Boston and Northern, 3; Suburban, 2½; Bay State, 2¼, and Union, 1½ per cent.

OFFICERS ELECTED.—The Central Union Telephone Company, of Chicago, has elected the following officers: Anson Stager, president; Norman Williams, first vice-president; D. H. Lauderback, second vice-president; W. S. Chapman, secretary and treasurer; F. G. Beach, general superintendent.

ABSORBED.—The Burlington (Iowa) Telephone Company has completed arrangements for the transfer of its property and franchises to the Iowa Union Telephone and Telegraph Company, which was recently organized for the purpose of establishing a complete telephone system throughout the State, and which will bring all the cities and towns in Iowa into telephonic communication.

ELECTION IN UTAH.—The following named gentlemen have been elected officers of the Utah Telephone Company: President, J. J. Dickey, of Omaha; vice-president, A. J. Pattison, of Ogden; secretary and treasurer, F. R. McConnel, of Salt Lake. Trustees—C. W. Lyman, of Salt Lake, and C. F. Annett, of Cheyenne. These gentlemen hold the property for the Rocky Mountain Bell Telephone Company.

TELEPHONE EXTENSION IN ILLINOIS.—Workmen were engaged last week in the construction of a telephone line from Mt. Vernon, Ill., to Woodlawn. As soon as this gap is filled in, Mt. Vernon will have telephone communication with Woodlawn, Ashley, Nashville, Richview, Irvington, Centralia, Odin, Sandoval, Carlyle and Salem. The line will be some seventy miles in length and will be completed in a few days.

THE SOUTHWESTERN COMPANY'S RIGHTS IN MEXICO.—In regard to the question as the right of the Southwestern Telephone Company to extend its business into Mexico, it is stated that the company is empowered by the Bell Company and the Mexican government to connect subscribers in the United States with subscribers in Mexico. A cable is being laid between Brownsville and Matamoras, and one is to be laid between El Paso and Paso del Norte. There are already sixty subscribers in Matamoras.

EXTENSIONS IN OHIO.—The Bell Telephone Company, of Cincinnati, is stringing a new line from Cincinnati, through Williamsburg and Mt. Oreb, to Georgetown, Brown County. From there connection will be made with Hillsboro and Ripley. This will connect by telephone the counties of Adams, Brown, Clermont, Clinton and Highland. The Midland Telephone Company is erecting a line between Port Clinton and Fremont. The line was to be completed by July 4.

THE WAR IN OSHKOSH.—The authorities of Oshkosh, Wis., are in great glee over the fact that the telephone company has paid the $300 license fee demanded. Payment was made under protest, the representative of the company who handed in the certified check stating that this was done merely because the telephone company had contracts which it was compelled to fill, and that when the present contracts for telephones expired the exchange would be removed from the city. The lines are repaired and the business is going on as before. It is now proposed to tax the telephone plant in the city as real estate, and collect both taxes and license.

PORTLAND, ME.—A paragraph from a correspondent, published June 30, asserting that the new telephone exchange, at Portland, is not giving the satisfaction promised, calls out the following card from Mr. J. H. Farnham, superintendent of the exchange: "I have made personal inquiry of hundreds of our subscribers as to the present service, and have yet to find one who is dissatisfied with it in any respect. Even some of our old chronic grumblers have taken pains to come to the office and extol the present system and service. In scores of cases we have taken pains to ascertain the time necessary to make connections (this, too, from subscribers' places of business, without any knowledge of the trials being given to the operators), and have found that from fifteen to thirty seconds is the average time, from the push of the button to speaking with the subscriber called. The operators are nearly all old hands who have been here years. For every subscriber who will say that the service is unsatisfactory, or not up to promises, or not equal to that of any other exchange, I will produce one hundred who will say that it is excellent and entirely satisfactory. Your correspondent has been misinformed, or has reported without ascertaining the facts; or, possibly, like the city officials and some others, is prejudiced against the company."

THE ELECTRIC LIGHT.

LETTING HIS LIGHT SHINE PROFITABLY.—Charles E Brush, the electric light man, is worth $1,500,000. He is letting his light shine most profitably.

LORD CHURCHILL'S HOUSE LIGHTED BY ELECTRICITY.—Lord Randolph Churchill now has his house in London lighted throughout by electricity supplied by a small gas engine in the cellar.

AN ELECTRIC LIGHT CONTRACT AWARDED.—On the 3d the lighthouse board at Washington awarded the contract for the construction of the electric light tower at Hallett's Point, New York Harbor, to the Cooper Manufacturing Company, of Mount Vernon, Ohio, for $11,120, the lowest bid of the seven offered for consideration.

NEW COMPANIES IN ILLINOIS.—The Thomson Houston Northwestern Electric Light and Power Company, of Chi-

cago, with a capital stock of $500,000; the incorporators are E. B. Hamlin, C. S. Jones and others. The Mendota Electric Light Company: capital, $15,000; incorporators, Max A. F. Hasse, Lewis R. Curtis, David Rude and Frank P. Snyder.

PETERED OUT.—The Springfield (O.) Electric Light Company has failed to receive sufficient support to enable a definite organization to be made in that city, as was proposed. The apparatus, which consisted of six large street lamps and numerous small lamps in stores, has been taken down. The absence of the electric light creates much dissatisfaction, and it is proposed to organize a smaller company with Mr. O. S. Kelly at its head, since the latter gentleman wishes to use the electric light for his arcade block and hotel, which will soon be opened.

READY FOR BUSINESS.—The charter of the McTighe Electric Light Manufacturing Company, of Pittsburgh, was filed for record on Monday, the 25th ult. The capital stock is $300,000, divided into 6,000 shares of the par value of $50 each. The incorporators are as follows: W. N. Riddle, 75 shares; Frank P. Laughlin, 75; E. M. Ferguson, 37; Walton Ferguson, 38; M. K. McMullin, 75; Thomas J. McTighe, 100; James J. McTighe, 100; and John M. Patterson, 100. Thirty thousand dollars of the capital stock has been paid in to the treasurer, F. B. Laughlin. The company has commenced the manufacture of its electric machinery.

ELECTION.—At the annual meeting of stockholders of the American Electric and Illuminating Company, at Denver, Col., the following directors were elected for the ensuing year: Silas Gurney, proprietor of the Tremont House, of Boston; Alderman C. S. Haldeman, of Boston; Col. H. M. French, of Boston; William A. Hovey, of Boston; William E. Hodgkins, of Charles A. Smith & Co., of Boston; Dr. J. G. Graves, of Nashua, N. H.; Henry Colony, of Colony Bros., woolen manufacturers, of Keene, N. H.; Charles B. Whiting, banker, of Worcester; C. D. Smith, of Boston; George A. Carter, of the American Express Company, of Saco, Me.; Edward H. Goff, of Boston.

CUTTING ELECTRIC LIGHT WIRES.—The city electrician of Chicago has declared war against certain of the electric light companies in that city by cutting all the wires not placed under ground. The competition has become so sharp between the companies that it is claimed that they do not use properly insulated wires, and that they string them at random on the housetops, where contact with them would result in instantaneous death. A number of wires have already been cut. This action has reference to arc lights only, no danger being apprehended from wires used in the transmission of currents for incandescent lighting.

ECCENTRIC ELECTRICITY UNDERGROUND.—During a heavy storm a week ago, while the guides were showing a large party through the Luray caverns in Virginia, the lightning struck one of the electric light wires and was carried into the caves, while it ran over the wires from one end to the other. The electric light globes were shivered into fragments, and the lightning gathered into big balls along the wire and exploded with loud reports. The scene for several minutes was terrific beyond description. The lightning flashing along wires looked like fiery serpents. One bolt shot from the wires and scattered the stalactites of the bridal chamber. When it disappeared, some of the party were left in total darkness.

AN ILLUMINATED DRESS.—The Jenkinses of the press frequently describe "brilliant" toilets, but a dress soon to be exhibited in London is the only one that has an undisputed right to this much-used and abused adjective. It is embroidered with wire thread, so arranged as to form myriads of tiny incandescent lamps, and connected with conducting wires terminating in the heels of the wearer. The dress does not attract attention until the wearer places her heel upon one of the small buttons in the floor, contrived for the purpose and connected below with an electric generator. The effect is magical; the whole costume bursts into dazzling brilliancy, and remains so as long as the wires continue in contact with the electric current. The patentee hopes to have this costume, or some modification of it, adopted for the stage.

BRUSH CONTRACT RENEWED AT CLEVELAND.—The Brush Company's contract for lighting the streets of Cleveland, O., expired on June 30, and the councils of that city neglected to provide for its renewal, until the last day of the month, when they authorized a renewal for three months. The press of Cleveland is unanimous in praise of the light and in deploring the negligence of the councils. The *Leader* says: "The light has given good satisfaction since its introduction here, and nobody can justly find fault with the manner in which the Brush Company have performed their part of the contract. The superiority of this light over gas has been fully demonstrated, and a return to the latter would surely meet with the disapproval of nine-tenths of the people of Cleveland, who naturally take pride in anything that adds beauty to the city. It has also been demonstrated that the difference in cost between the Brush light and gas is, considering the difference in quality, but trifling."

THE LOUISVILLE EXPOSITION.—The contract for lighting the Louisville Exposition building has been awarded to the Edison Electric Light Company, of New York. The building is to be lighted with 4,600 Edison incandescent electric lights of sixteen-candle power each. This is the largest undertaking of the kind ever known, and the plant to be used will be larger than even that at the great London exhibition of electric lights held last year. The exposition is the largest building ever lighted with electricty. The amount of copper wire used will weigh 40,000 pounds, and if stretched out would reach forty miles. Some of the wire is very thick. There will be fifteen dynamo machines worth about $4,000 each. To move them will require four Armington & Sims engines and one large Reynolds Corliss engine, the latter being furnished by the exposition company. The plant will cost in all about $100,000. It will be as large as would be required to supply a town with 20,000 lamps, as not more than one-fifth of the lamps in a town are usually burning at the same time. It will be equal to a gas plant making 35,000 cubic feet of gas an hour.

MISCELLANEOUS NOTES.

UNDERGROUND PRIVILEGES GRANTED.—The bill granting permission to the Philadelphia Sectional Underground Company to lay its conduits in the streets of that city has passed the City Councils.

GRAY.—Mr. Elisha Gray, who was at one time a student in Oberlin College, and who has given the college $50,000, was in Oberlin, O., last week, attending the semi-centennial celebration of his *alma mater*.

THE NEW YORK ELECTRICAL SOCIETY.—Members of the N. Y. Electrical Society can get books from the librarian, Mr. J. F. Fairman, at Hall No. 2, Inventor's Institute, Cooper Union, as the library is now open.

FIRE ALARM.—The Southern Electric Company, of Baltimore, has introduced the Gamewell system of fire alarm telegraph at York, Pa. The system is the same that is in use at Baltimore. It was finished at York on July 4.

NO ESCAPE.—Engineers say tunnels are to supersede big bridges in the future; that telegraph wires, telephone wires and pneumatic tubes for long distances will all be laid under ground. But by that time we will probably all be under ground, too.—*Cincinnati Commercial Gazette.*

THE CHICAGO ELECTRICAL RAILROAD.—Twenty-six thousand eight hundred and five passengers were carried over the electric railway in the exposition building, Chicago, which was in operation for business fourteen days. During that time 1,558 trips were made, representing a total of 46,624 miles traveled by the electrometer and the car attached.

ELECTRICITY EMBALMED IN MARBLE.—Mr. D. C. French, the sculptor who made the group of Science Controlling the Forces of Electricity and Steam in the Boston Post office, has made a companion piece for the same place, representing Labor Supporting the Home and Promoting the Fine Arts. The groups might have been given more attractive titles.

BROOKS UNDERGROUND SYSTEM.—The laying of the underground conduits of the Brooks system was begun on June 28, on Front street, above Market, Philadelphia, and when completed will extend to the Kensington Depot. In order not to interfere with the traffic on the streets, the conduits are to be laid in sections of 2,000 feet each, so that the street can be repaired at once.

ELECTRIC APPLIANCES FOR PROMOTING ARTIFICIAL RESPIRATION.—One of the medical men who were brought into connection with the Sunderland accident in England has pointed out that very many of the victims might have been saved if electric appliances for promoting artificial respiration had been immediately available, and he suggests that such apparatus should be kept in every large place of public entertainment.

RUMORS OF A STRIKE DENIED.—Grand Secretary Hughes, of the Brotherhood of Telegraphers, denies the rumors of an impending strike among telegraph operators. He says there are about 17,500 operators in the United States and 2,500 in Canada. Of these 20,000, 15,000 are railroad and 5,000 commercial operators. He claim that nine-tenths of the commercial and half the railroad operators are members of the Brotherhood.

AN ELECTRIC SHOCK.—During the thunder shower on the 3d, lightning struck the steeple of Trinity Church at Port Richmond, glanced to the roof and made a deep rut in the shingles down to the eaves. The shingles were set on fire, but a heavy shower immediately put out the flames. Two dockmen were seated on a string-piece at the landing, when the lightning struck the water near them, causing the legs of the two men to become so benumbed by the electric shock that they were unable to walk for some hours afterward.

AWARDS AT CHICAGO.—Among the awards for electrical devices at the Chicago Railway Exposition we notice a gold medal to the Electric Railway Company of the United States for the best electric railway system; a gold medal to the United States Electric Light Company for the best electric motor for stationary purposes; a gold medal to the Union Switch and Signal Company for best electric signaling device for block or other signals; three silver medals to the Western Electric Company, one for for the best time detector, electric clock and register, another for best display of telegraph instruments and supplies, and a third for the best key relay and sounder complete.

CURIOUS FREAKS OF LIGHTNING.—There is nothing in the history of electrical science to excel the wonderful freaks of the lightning during the recent storm in Greenville. Says the *New York Star*: Mrs. Bocsein, according to the veracious reporter, was sitting on the back porch with her feet upon a stool and working upon a quilt, her scissors lying on the rail of the porch, when the lightning passed under her chair, overturning her stool and tearing the heel from her slipper. Again, while drinking a cup of tea, she was knocked against the wall by the shock. The lightning passed through the foundation and broke the iron pump in the kitchen. Nobody badly hurt.

A CONDUIT COMPANY'S UNPAID FEES.—The Philadelphia *Times* says: It appears that the impoverished National Underground Electric Company, of Camden, is in arrears in its fees due to this city. The company, in order to extend its conduits, has levied a tax of two cents a share on the stockholders. This will realize about $9,000. The amount owed the city by the corporation in May last was $5,200. Since that time the penalties have been steadily running on at the rate of $100 a day, $50 for non-payment of the tax on the conduits and $50 for non-payment of tax on the wires. The present indebtedness of the company to the city is about $9,000. The city authorities say that Chief Estabrooke, of the Highway Department, and Superintendent Phillips cannot permit the company to lay additional conduits until this has been paid in.

A SINGULAR FREAK OF LIGHTNING.—During a thunderstorm on the 4th lightning struck one of the towers of the Exposition building at Indianapolis, Ind., and performed an unusual feat. After going through the roof it struck a water tank, passing through eight feet of water and knocking a hole in the bottom of the tank large enough to let all the water out. From the tank the streak pursued its way downward through the building, leaving very plain marks and landing safely in the ground. Considerable astonishment is expressed by the Western papers at the fact that the electrical streak passed through such a mass of water without having its fiery ardor quenched more or less. In reality, however, this is no more wonderful than the fact that electrical currents may be obtained in conductors attached to a voltaic battery in which the electricity has to pass through the exciting liquids of the battery. The liquid in both cases is simply a conductor having a definite resistance.

A FREE ELECTRIC DISPLAY.—There are persons who delight in the panoramas which electric storms afford when the electricity keeps a proper distance. All on Staten Island who possessed a taste for scenic display of this order had an opportunity on Thursday evening of gratifying it. The thunder storm which passed over that section to the eastward about 7 o'clock was followed by very vivid lightning in the distance, the flashes following each other in rapid succession. As the electric current pierced the heavy banks of cloud, it imparted to them a bright pink tint, probably caused by the reflection from the setting sun, hidden from view, thus forming a beautiful background, through which shot the current proper, taking the shape of a delta, whose brilliant arms darted hither and thither with an unwonted recklessness. Many residents enjoyed the panorama from their piazzas, while congratulating themselves that Edison *et al.* had not yet rendered it possible for the American speculator to "fence in" and charge a fee for the "show;" and all but the most timid were ready to forgive the deadly element its cruelty for the beauty of its display.

TRYING TO REVIVE A DEFUNCT UNDERGROUND SCHEME IN PHILADELPHIA.—An effort was made in Philadelphia last week to regalvanize the "National Underground Electric Company," which, by a sudden collapse in the price of its stock two years ago, "let in" a good many residents of the staid old Quaker City. At that time conduits were actually laid for over a mile on Market street, from Front street to the new City Hall, and it is now reported that the chambers are all dry and in good condition. In the expectation that the Baltimore & Ohio Telegraph Company will lease some of the conduits, it has been decided to levy an assessment of two cents per share to continue the system on Market street west to the Schuylkill River, and on Tenth and Third streets south to Chestnut street. The assessment, if paid in, will yield a revenue of $9,000, sufficient to cover all the necessary expenses; but as the stock suddenly fell two years ago from 145 to 20, and never recovered more than 5 per cent., it is doubtful if the broad-brimmed citizens of Philadelphia will take kindly to the new scheme, especially since it is understood that the company owes the city some thousands of dollars for back taxes.

STOCK QUOTATIONS.—Telegraph, telephone and electric light stocks were quoted on Tuesday of last week and Wednesday of this week as follows:

	July 3.	July 11.
American Cable	68	68
Bay State Telephone	137	133
Bell Telephone	269	276
Boston & Northern Telephone	147½	150
Bell Telephone Co. of Missouri	....	165
Brush Electric Light (Cleveland)	....	100
Brush Illuminating Co., N. Y	....	100
Consolidated Telephone Co	....	2½
Central New York Telephone & Telegraph	....	105
Central Union Telegraph Company	....	110
Edison Electric Light	....	200
Empire State Telephone & Telegraph Co	....	200
Hudson River Telephone & Telegraph Co	....	110
Iowa Union Telephone Co	....	102
Long Island & New Jersey Telephone Co	....	114
Mexican Telephone Co	2½	2½
Missouri & Kansas Telephone Co	....	100
National Bell Telephone of Maine	79	....
People's Telephone Co	....	7½
Southwestern Telephone Co	....	68
Suburban Telephone Co	138	139
Southern Bell Telephone & Telegraph	....	125
Tropical Telephone	2½	2¼
U. S. Electric Light	128	128
United Telephone Co., Kansas & Missouri	....	97
Western Union Telegraph	83⅛	83½

ELECTRICAL PATENTS ISSUED

And Dated July 3, 1883.

Apparatus and system for telephonic communication; Albert Dunand, Paris, France 280,365
Automatic roll-call for telegraph-lines; Wm. P. Harris, South Chicago, Ill. 280,616
Automatic indicator switch for telephone systems; Geo. L. Anders, Boston, Mass. 280,707
Carbon for incandescent electric lamps; Alexander Bernstein, Boston, Mass. 280,341
Dynamo-electric machine; R. Edward Ball, New York, N. Y. 280,439
Dynamo-electric machine; Foreé Bain, Minneapolis, Minn 280,708
Duplex and quadruplex telegraphy; Alexander Muirhead, London, England 280,753
Electric burglar alarm; Orlando A. Helman, Cincinnati, Ohio 280,472
Electric cable or conductor; Louis Adolphe Fortin Herrmann, Paris, France 280,474
Electric conductor or cable; James Webb Rogers, New York, N. Y. 280,518
Electric cable; William H. Sawyer, Providence, R. I. .. 280,521
Electro-magnetic locomotive; Samuel H. Beckwith, Utica, N. Y. 280,559
Electrical measuring apparatus; Charles S. Bradley, New York, N. Y. 280,563
Electric burglar alarm attachment for automatic signaling apparatus; William F. Chester, New York, N. Y. 280,578
Electric light; Faunt L. Senour, New Alexandria, Pa. . 280,677
Electric-arc lamp Foreé Bain, Minneapolis, Minn 280,709
Electric clock system; Charles E. Buell, New Haven, Conn. 280,715
Electric-arc lamp; Franz Rabl, Camden, N. J 280,763
Focus-regulator for electric-arc lamps; Wm. Wheeler, Concord, Mass. 280,426
Fire-alarm or district telegraph; William B. Vansize, Brooklyn, N. Y. 280,536
Incandescent electric lamp; Alexander Bernstein, Boston, Mass. 280,340
Insulated electrical conductor; Thomas H. Dunham, Boston, Mass. 280,366
Insulating material for electrical uses; Richard S. Waring, Pittsburgh, Pa. 10,350
Machine for making electric cables; Ernest E. Rafer and Eugene G. Rafer, St. Chamond, France 280,764
Process of and apparatus for insulating wires for electric uses; Richard S. Waring, Pittsburgh, Pa. 10,349
Switch-board for telephones; Henry Clay, Philadelphia, Pa. 280,351
Switch-board for telephone central offices; Thomas J. Perrin, Brooklyn, N. Y. 280,662
System of electrical distribution; Thomas A. Edison, Menlo Park, N. J. 280,727
Telephone call-bell; Henry Clay, Philadelphia, Pa. 280,451
Transmitter for telephones; Henry Clay, Philadelphia, Pa. 280,580
Telephone switch-board; Thomas J. Perrin, Brooklyn, N. Y. 280,663

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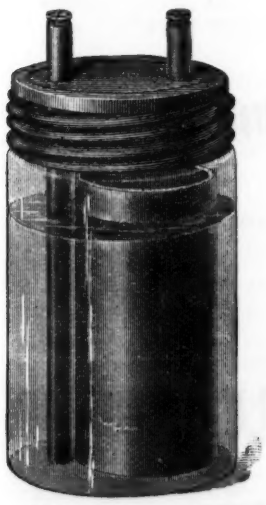

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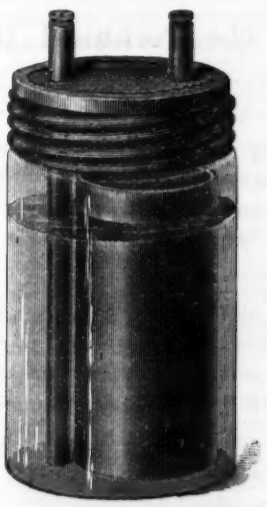

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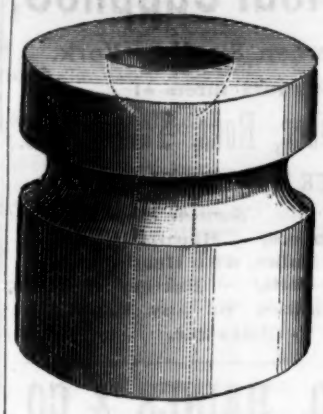

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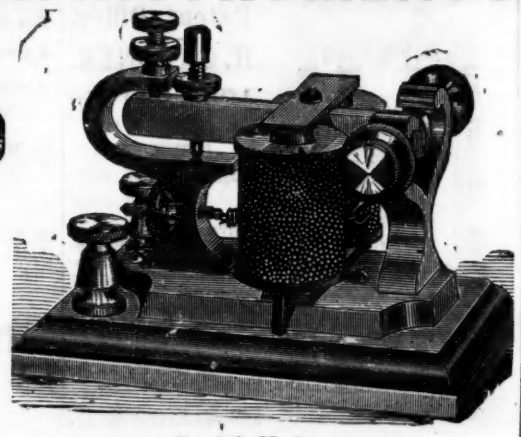

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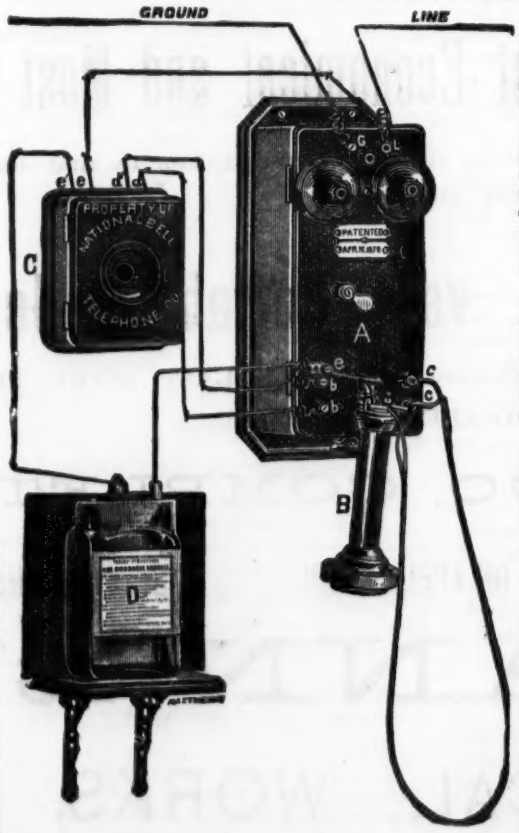

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PRACTICAL INFORMATION FOR TELEPHONISTS. By T. D. LOCKWOOD, Electrician, American Bell Telephone Company. 12mo, cloth. New York, 1882. $1.00.

CONTENTS.

Historical Sketch of Electricity from 600 B. C. to 1882 A. D.—Facts and Figures about the Speaking Telephone—How to Build a Short Telegraph or Telephone Line—The Earth and its Relation to Telephonic Systems of Communication—The Magneto-Telephone; What it is, How it is made, and How it should be handled—The Blake Transmitter—Disturbances Experienced on Telephone Lines—The Telephone Switch-Board—A Chronological Sketch of the Magneto-Bell, and How to Become Acquainted with it—Telephone Transmitter Batteries—Lightning; its Action upon Telephone Apparatus; How to prevent or reduce Troubles Arising therefrom—The Telephone Inspector—The Telephone Inspector; his Daily Work—The Inspector on Detective Duty—The Daily Routine of the Telephone Inspector—Individual Calls for Telephone Lines—Telephone Wires *versus* Electric Light Wires—Electric Bell Construction—Housetop Lines, Pole Lines and Aërial Cables—Anticipations of Great Discoveries and Inventions.

The chapters of which this book is composed were originally published in THE OPERATOR, where they were found so useful to practical telephone men as to induce an imperative demand for their re-publication in the present convenient form. The book, while giving a mass of valuable information, such as could only be acquired by an extended practical experience with the telephone, is written in an easy, chatty style, which makes it entertaining reading. It is the only book that contains a description of the Blake transmitter, now used almost universally throughout the United States. No one who has anything to do with telephones can fail to find in it something of interest or value; but it is particularly useful to the managers and employés of telephone exchanges, as it gives them valuable instruction about every detail of their work.

THE TELEPHONE. An Account of the Phenomena of Electricity, Magnetism and Sound, as Involved in its Action; with Directions for Making a Speaking Telephone. By A. E. DOLBEAR. Second Edition. 18mo, cloth, 17 illustrations. Boston, 1883. 50c.

CONTENTS.

Electricity—Magnets—The Galvanic Battery—Other Means for Generating Electricity—What is Electricity?—Sound—Correlation—Reiss, Gray, Bell and Dolbear Telephones—How to Make a Telephone.

A very interesting little volume, which clearly explains the fundamental principles of the telephone in an able manner. The first edition had a large sale, and the demand for the book still continuing, a second edition has just been issued at a reduced price.

THE TELEPHONE. A Lecture by PROF. ALEXANDER GRAHAM BELL, Delivered before the Society of Telegraph Engineers. 8vo, paper, 30 illustrations. London, 1870. 60c.

This is a complete and concise account of the stages of experimentation gone through by Professor A. Graham Bell, before his researches resulted in one of the greatest triumphs of modern science. All who believe Bell to be the original inventor of the speaking telephone should have a copy of the work from which to quote. All who believe that he was not, should have one, so as to acquaint themselves with what can be advanced in support of the claims made for Bell. In fact, everybody interested in telephony should read it.

THE TELEPHONE, THE MICROPHONE, AND THE PHONOGRAPH. By COUNT DU MONCEL. Authorized Translation, with Additions and Corrections by the Author. 12mo, cloth, 70 illustrations. $1.25.

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THE SPEAKING TELEPHONE, ELECTRIC LIGHT, AND OTHER RECENT ELECTRICAL INVENTIONS. By GEORGE B. PRESCOTT. 8vo, cloth, 319 illustrations and 1 plate. New York, 1879. $4.00.

CONTENTS.

The Speaking Telephone—Bell's Telephonic Researches—The Telephone Abroad—History of the Production of Galvanic Music—Gray's Telephonic Researches—Edison's Telephonic Researches—Electro-Harmonic Telegraphy—Dolbear's Telephonic Researches—Improvements of Channing, Blake and others—The Talking Phonograph—Quadruplex Telegraphy—Electric Call Bells—The Electric Light—Edison's Recent Telephonic and Acoustic Inventions—Duplex Telegraphs, Electro-Magnets and Electric Time Service.

This is a large and handsome work, the object of which is to furnish the public with a clear and accurate description of the more recent and useful improvements in electrical science, and especially to explain the principles of that marvelous production, the speaking telephone. The most interesting portion of the work, to most readers, is the history of the original telephonic researches of Bell, Gray and Edison, the account of each inventor's experiments being given in his own words. It contains also a very thorough description and explanation of the quadruplex telegraph, with numerous diagrams, showing how the wires are arranged, and gives excellent accounts of the Brush, Maxim, Jablochkoff, Thomson-Houston, and other systems of electric arc lighting, with descriptions of the dynamos, etc. The illustrations throughout the work are very fine.

ELECTRIC LIGHTING.

ELECTRIC LIGHT, ITS PRODUCTION AND ITS USE; EMBODYING PLAIN DIRECTIONS FOR THE WORKING OF GALVANIC BATTERIES, ELECTRIC LAMPS AND DYNAMO-ELECTRIC MACHINES. By J. W. URQUHART, C.E. Edited by F. C. WEBB, M.I.C.E., etc. 8vo, cloth, 94 illustrations. London, 1880. $3.00.

CONTENTS.

Introduction—Voltaic Batteries—Thermo-Electric Batteries—Magneto-Electric Generators—Electro Magnetic Electric Machines—Dynamo-Electric Machines—General Observations on Machines—Electric Lamps and Candles—Measurement of Electric Light—Mathematical and Experimental Treatment of the Subject—Application and Cost of the Electric Light.

A very convenient and complete treatise on the electric light. The principles are defined in a manner devoid of technicalities, so as to render the book very valuable to the beginner. The history of the dynamo-electric machine and its development, from the Pixii to the Gramme machine, is also quite complete. The recent types of machine receive a full share of attention and the various styles of lamps are treated in full.

ELECTRIC LIGHTING. Translated from the French of LE COMTE TH. DU MONCEL, by ROBERT ROUTLEDGE, B.Sc. Crown 8vo, cloth, 76 illustrations. London, 1882. $1.25.

CONTENTS.

General Considerations—Generators of Electric Light—Electric Lamps—Cost of Electric Lighting—Applications of Electric Light—Conclusion—Notes and Appendices.

A translation of the work of this prolific writer on electrical subjects, published at Paris, in 1880, under the title of "L'Eclairage Electrique," to which the translator has added brief accounts of the apparatus connected with electric lighting which have been brought forth since the publication of the original edition, viz., Swan's, Maxim's, Edison's, and Fox-Lane's incandescent lamps, and the Faure secondary battery. To the student or the general reader who desires information free from abstruse technicalities, and at an insignificant cost, on a subject that is attracting general attention, this work, the original of which is one of a popular science series, can be recommended. The object held constantly in view by the author was to make the treatise thoroughly practical. The book is the cheapest one that aims to cover the whole ground of electric lighting.

ELECTRIC LIGHTING AND ITS PRACTICAL APPLICATION; WITH RESULTS FROM EXISTING EXAMPLES. By J. N. SHOOLBRED. 8vo, cloth, 5 plates. London, 1879. $2.00.

CONTENTS.

Historical and Descriptive—Electric Light Machines—Lamps and Regulators—Carbons; Conducting Wires—Motive Power—Luminous Intensity—Applications; Economic Results—Prospects of Electric Lighting.

A handy little treatise, very valuable to the beginner. The author adopts a popular method of treating the subject and avoids technicalities as much as is compatible with the precision of the work. The history of the early efforts in this field is given, the apparatus being briefly described in each case. The notice of recent inventions, up to the date of print, is quite complete. The questions of power and of photometry form the subjects of very interesting and instructive details.

USEFUL INFORMATION ON ELECTRIC LIGHTING. By KILLINGWORTH HEDGES, M.S.T.E. Fourth Edition, Revised and Enlarged. Crown 8vo, cloth, 20 plates. London, 1883. $1.75.

CONTENTS.

Production of Electricity—Voltaic Arc—Division of the Electric Light—Machines or Generators—Power required, and Motors—Application of the Electric Light—Choice of a System—Setting to Work—Cost of Working—Measurement of Light and Current—Storage of Electricity and Transmission of Power—Electrical Measurement of Work—Useful Memoranda.

The first edition of this work met with so great a success as to encourage the issue of enlarged second and third editions, which have in turn been exhausted. A fourth edition, still further enlarged, has just been issued.

ELECTRIC LIGHTING BY INCANDESCENCE, AND ITS APPLICATION TO INTERIOR ILLUMINATION. A Practical Treatise. By WILLIAM E. SAWYER. 8vo, cloth, 96 illustrations. New York, 1881. $2.50.

CONTENTS.

Introduction—Generators of Electricity—Generators of the Gramme Type—Generators of the new Siemens Type—Incandescent Lamps—Carbons for Incandescent Lighting—New Forms of Lamps—Preservation of Incandescent Carbons—Division of Current and Light—Regulators and Switches—General Distribution—Commercial Aspects.

This book is an indispensable addition to the libraries of all who desire to keep up to the age in the novelty of electric lighting. Its author neglects the arc light altogether, and gives his readers a graphic account of the generators employed in the production of the necessary currents; of those lamps which utilize the currents when generated; of the most advantageous circuit arrangements and apparatus, and of the best materials to use in lighting by incandescence. A historical sketch shows that the idea of electric lighting by incandescence is as old almost as telegraphy itself. The book is handsomely printed and copiously illustrated.

INCANDESCENT ELECTRIC LIGHTS, WITH PARTICULAR REFERENCE TO THE EDISON LAMPS AT THE PARIS EXHIBITION. To which is added The Economy of the Electric Light by Incandescence, by JOHN W. HOWELL; and On the Steadiness of the Electric Current, by C. W. SIEMENS. Illustrated. 18mo, boards. New York, 1882. 50c.

There is no book that contains more valuable information in the same space than this. On the question of incandescent lights it must be considered the best authority at present accessible. The tables and data given help very much in analyzing facts and making comparisons. The article by Mr. C. W. Siemens is especially valuable and interesting. It refers to a new method of exciting the field of dynamo-electric machines, which enables the current to maintain itself constant in the external circuit, no matter how great and rapid the variations of resistance may be. This method has come into use as a most valuable adjunct in the dynamos intended for incandescent lamps, where it enables any of the lamps to be put on and off at will without affecting the rest. For this reason this article is of great interest to every person interested in electric lighting.

VARIOUS APPLICATIONS.

ELECTRO-MOTORS. A Treatise on the Means and Apparatus employed in the Transmission of Electrical Energy and its conversion into Motive Power. By J. W. URQUHART. 12mo, cloth, illustrated. London, 1882. $3.00.

CONTENTS.

Introduction—On the Dynamical Nature of Electric Currents—Electrical Measurements—Electro-Magnetic Force—Electro-Magnets and Armatures—Electric Accumulators or Magazines—The Construction and Efficiency of Electro-Motive Machines—Electric Railways—Minor Applications of Electro-Motive Energy—Fragmentary Information.

Undoubtedly the best motors are to be studied from the best generators, since it has been proved that they are mutually reversible; but there are many cases where a motor of a special form and kind is required in order to adapt it to special circumstances and conditions. From this point of view Mr. Urquhart's book fills a void, being the only book on the subject. It contains much interesting and useful information regarding the use of electro-motors industrially, and makes a desirable little book.

ELECTRIC TRANSMISSION OF POWER; ITS PRESENT POSITION AND ADVANTAGES. By PAGET HIGGS, LL.D., D.Sc. Crown 8vo, cloth, 21 illustrations. London, 1879. $1.20

CONTENTS.

Dynamo-Electric Machines—The Gramme Machine—The Brush Machine—The Wallace-Farmer and Siemens' Machines—Efficiency of Dynamo-Electric Machines—Practicability of Transmission of Power by Electricity—Efficiency of Coupled Machines—Comparative Efficiency of Various Machines—Other Theoretical Considerations—Conclusions.

Treats of a new and growing application of electricity, and one destined to become of great industrial importance. The writer discusses impartially the efficiency of the various dynamos for the transmission of power, having no system of his own to advocate.

BOOKS ON SEPARATE BRANCHES OF ELECTRICITY.

ELEMENTARY TREATISE ON ELECTRIC BATTERIES. From the French of ALFRED NIAUDET. Translated by L. M. FISHBACK, of the Bell Telephone Company of Missouri. Second Edition. 12mo, cloth, 55 illustrations. New York, 1882. $2.50.

CONTENTS.

I.—Single-Liquid Batteries—Description of Volta's Battery and its Derivatives—General Remarks upon Batteries—Sulphuric Acid Batteries—Acid Batteries Analogous to that of Volta—Batteries without Acids—Other Batteries. II.—Two-Liquid Batteries—The Daniell Battery—Gravity Batteries—General Remarks upon Daniell Batteries—Batteries Derived from the Daniell—Acid Batteries—Oxides in Batteries—Chloride Batteries—Depolarizing Mixture Batteries. III.—Various Batteries—Tables.

Mr. George d'Infreville, one of the electricians of the Western Union Telegraph Company, writes: "This work will serve to guide the uninitiated in the choice and management of batteries, and even the professional electrician may find, not only new matter, but even old material, presented in a new form and worked to new developments. Telegraphers generally will find many of their frequently recurring problems solved in its pages, and its perspicuity will save both inventor and investigator from making useless experiments or errors, while at the same time the work offers to all new fields for careful research. Although the subject treated is so useful and interesting, yet this is, I believe, the first time it has received such recognition in English as its importance demands."

FOUR LECTURES ON STATIC ELECTRIC INDUCTION. By J. E. H. GORDON, B. A. 18mo, cloth, 39 illustrations. New York, 1881. 80c.

CONTENTS.

Introductory—Preliminary Experiments—Induction a State of Strain—How the Electric Strain is Propagated—Faraday's Experiments—Specific Inductive Capacities of Different Media—The Electro-Magnetic Theory of Light—Actions of Electricity on Light and *Vice Versa*.

Electro-static induction is a most important factor in underground and cable telegraphy and in telephony, and some knowledge of it is an essential preliminary to the study of the action of dynamo-electric machines. This little volume tells what it is and how it acts, and elucidates some of the most profound of modern electrical theories, in language that any one can understand.

INDUCTION COILS. HOW MADE AND HOW USED. DYER. Reprinted from the Eighth English Edition. 16mo, boards, 63 illustrations. New York, 1881. 50c.

CONTENTS.

Current Electricity—Galvanic Batteries—Batteries, How Constructed—Induced Electricity—How a Coil is Made—How an Intensity Coil is Made—How an Intensity Coil is Used—Vacuum Experiments.

This interesting little book may be regarded as a complement of the one last mentioned, the former relating exclusively to electro-static induction, or the inductive effects of electricity at rest, while the latter treats of electro-dynamic induction, or the inductive effects of electricity in motion. The title of the book and the brief table given above convey an imperfect idea of its varied contents. Like the previous work, it is written in simple language. It tells how to make the various forms of the apparatus, and describes a great many beautiful and interesting experiments that may be made by means of it. It is, therefore, just the kind of book the student wants who "means business."

A HAND-BOOK OF THE ELECTRO-MAGNETIC TELEGRAPH. By A. E. LORING. 18mo., 26 illustrations. New York, 1878. Boards, 50c.; cloth, 75c.; morocco, $1.00.

CONTENTS.

Electricity and Magnetism—The Morse Telegraph—Batteries—Practical Telegraphy—Construction of Line—Suggestions and Exercises for Learners.

This is a little book which can be conveniently carried in the pocket by the student. The writer is a practical telegraph operator. In addition to clearly explaining the common Morse telegraphic apparatus, it tells how to proportion instruments and batteries to the lines, and describes the ordinary methods of testing for crosses, grounds, breaks, escapes, etc. It is an excellent book for the beginner.

HANDBOOK OF NATURAL PHILOSOPHY. ELECTRICITY, MAGNETISM AND ACOUSTICS. By DIONYSIUS LARDNER, D.C.L. Ninth Thousand. Edited by Prof. G. C. FOSTER. 8vo, cloth, 400 illustrations. London, 1874. $2.00.

CONTENTS.

Electrical Attractions and Repulsions—Conduction—Induction—Electrical Machines—Condenser and Electrophorus—Electroscopes—The Leyden Jar—Laws of Electrical Forces—Mechanical Effects of Electricity—Thermal Effects of Electricity—Luminous Effects of Electricity—Chemical and Magnetic Effects of Electricity—Sources of Electricity—Simple Voltaic Combinations—Voltaic Batteries—Voltaic Currents—Reciprocal Influence of Rectilinear Currents and Magnets—Electro-Magnetic Induction—Influence of Terrestrial Magnetism on Voltaic Currents—Reciprocal Influence of Voltaic Currents—Voltaic Theory of Magnetism—Reoscopes and Reometers—Photomagnetism and Diamagnetism——Thermo-Electricity—Electro-Chemistry—Electro-Metallurgy—Electro-Telegraphy—Calorific, Luminous and Physiological Effects of the Voltaic Current—Magnetism; Definitions and Primary Phenomena—Magnetism by Induction—Terrestrial Magnetism—Magnetization—Acoustics—Theory of Undulations—Production and Propagation of Sound, Physical Theory of Music—Vibrations of Rods and Plates—Vibrations of Fluids—The Ear.

Treating of Electricity, Magnetism and Acoustics—the three elements that are united in the telephone—this volume may be appropriately studied as an introduction to the theory of that instrument, though written before the telephone was invented. The work has been so long and so well known, and has had so extensive a circulation, that it deserves to be called a classic among English text-books.

LIGHT AND ELECTRICITY. Notes of two Courses of Lectures before the Royal Institution of Great Britain. By JOHN TYNDALL. 12mo, cloth. New York, 1881. $1.25.

CONTENTS OF THE PORTION RELATING TO ELECTRICITY.

Voltaic Electricity; the Voltaic Battery—Electro-Magnetism; Elementary Phenomena—Electro-Magnetic Engines—Physical Effects of Magnetization—Character of Magnetic Force—Magnetism of Helix; Strength of Electro-Magnets—Electro-Magnetic Attractions; Law of Squares—Inference from Law of Squares; Theoretic Notions—Diamagnetism; Magne-Crystallic Action—Frictional Electricity; Attraction and Repulsion; Conduction and Insulation—Theories of Electricity; Electric Fluids—Electric Induction; the Condenser; the Electrophorus—The Electric Machine; the Leyden Jar—The Electric Current—The Electric Discharge; Thunder and Lightning—Electric Density; Action of Points—Relation of Voltaic to Frictional Electricity—Historic Jottings concerning Conduction and the Leyden Jar—Historic Jottings concerning the Electric Telegraph—Phenomena Observed in Telegraph Cables—Artificial Cables—Sketch of Ohm's Theory and Kohlrausch's Verification—Electro-Chemistry; Chemical Actions in the Voltaic Cell; Origin of the Current—Chemical Actions at a Distance; Electrolysis—Measure of the Electric Current—Electric Polarization; Ritter's Secondary Pile—Faraday's Electrolytic Law—Nobili's Iris Rings—Distribution of Heat in the Circuit—Relation of Heat to Current and to Resistance—Magneto-Electricity; Induced Currents—Relation of Induced Currents to the Lines of Magnetic Force; Rotary Magnetism—The Extra Current—Influence of Time on Intensity of Discharge; the Condenser—Electric Discharge through Rarefied Gases and Vapors—Action of Magnets on the Luminous Discharge—Magneto-Electric Machines; Saxton's Machine; Siemens' Armature; Wilde's Machine; Siemens' and Wheatstone's Machine—Induced Currents of the Leyden Battery.

As we remarked above, in speaking of Prof. Tyndall's "Lessons in Electricity," there is no better expositor of the principles of electrical science. The present volume contains notes of two series of lectures on Light and Electricity, for a more mature audience that to which the former series was addressed.

GENERAL TREATISES.

WONDERS OF ELECTRICITY. Translated from the French of J. BAILE. Edited, with Numerous Additions, by Dr. JOHN W. ARMSTRONG. 12mo, cloth, 65 illustrations. New York, 1872. $1.25.

CONTENTS.

Introduction—Electric Telegraph—Induction Machine—Electric Light—Electro-Plating—Appendix.

This interesting book reviews in a popular way the history, the phenomena and the applications of electricity. To the layman who desires to acquire general information regarding the capabilities of the science, this book will commend itself readily by the simplicity and lucidity of its descriptions, and the interesting, narrative way of presenting the topics. There are two appendices, the work of the translator, which are of evident value. The first of these relegates to American genius the credit of that invention known as the Ruhmkorff coil, and constitutes a very able and complete review of the labors of Prof. Page and others in this field.

ELECTRICAL TABLES AND FORMULÆ FOR THE USE OF TELEGRAPH INSPECTORS AND OPERATORS. Compiled by LATIMER CLARK and ROBERT SABINE. 12mo, cloth. London, 1871. $5.00.

This is an immense aggregation of isolated facts, figures and formulæ, collated in such form as to be available for ready reference. Definitions are given of the various electrical units, and the laws of electricity, magnetism and electro-magnetism are clearly stated. The different methods of localizing faults in aërial and submarine lines are also described. Convenient recipes and tables of every sort and size complete the book.

CANDLE-POWER OF THE ELECTRIC LIGHT. By PAGET HIGGS, LL.D., D.Sc. Crown 8vo, paper. 25c.

CONTENTS.

Comparison of Various Arc Lights—Comparison of Various Incandescent Lights—Economical Ratio of these Systems of Lighting—Relation of Lighting Power to Quantity of Current—Sources of Loss in Existing Lamps.

The determination of the candle-power of the electric light is a matter of much importance in its bearing upon the question of the comparative economy of electricity and gas as means of illumination. Its importance is illustrated by the fact that the publishers deemed this little pamphlet of thirteen pages to be worth seventy-five cents. The sale of the book was so much larger than expected that the price has recently been reduced to twenty-five cents.

ELEMENTS OF CONSTRUCTION FOR ELECTRO-MAGNETS. By COUNT TH. DU MONCEL. Translated from the French by C. J. WHARTON. 8vo, cloth, illustrated. London 1883.

CONTENTS.

Introduction—Formulas for Electro-Magnets—Conditions of Maximums for Electro-Magnets on a Simple Circuit—Conditions of Maximum on Compound Circuits—Application of the Laws of Maximum to the Construction of Electro-Magnets—Numerical Examples of the Application of the Preceding Formulas—Experimental Verification of the Laws of Electro-Magnets—Effects of a More or Less Complete Magnetic Saturation—Condition for the Good Construction of Electro-Magnets—On the Best Grouping of the Cells of a Battery.

This is a work on a timely subject, which has just been published. It is the only book which treats of the construction of electro-magnets, a matter which has an important bearing upon the efficient working of telegraph lines, dynamo-electric machines, and other applications of electricity and magnetism.

ELECTRO-MAGNETS: The Determination of the Elements of their Construction. By TH. DU MONCEL. Translated from the Second Edition. 18mo, boards. New York, 1883. 50c.

This is practically the same as the last mentioned work, but is a cheaper, American edition.

THE GALVANOMETER AND ITS USES. A Manual for Electricians and Students. By C. H. HASKINS. Second Edition, Revised. 12mo, morocco, 8 illustrations. New York, 1881. $1.50.

CONTENTS.

Explanatory Chapter—Various Forms of the Galvanometer—Formulæ and Tables.

As electrical science advances and our telegraphs increase, the importance of a knowledge of the use of the galvanometer becomes greater every day. Only he who has used the galvanometer can fully appreciate the value of Mr. Haskins' handbook. It is small, condensed, complete, and as full of information about galvanometers and their uses as an egg is of meat.

REPORTS OF THE COMMITTEE ON ELECTRICAL STANDARDS APPOINTED BY THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Revised by Sir W. THOMSON, Dr. J. P. JOULE, Professors J. CLERK MAXWELL and F. JENKIN. With a Report to the Royal Society on Units of Electrical Resistance, by Prof. F. Jenkin; and the Cantor Lectures, Delivered by Prof. Jenkin before the Royal Society of Arts. Edited by Prof. Fleeming Jenkin, F.R.S. 8vo, cloth. London, 1873. $3.75.

The nature of the contents of this volume is fully expressed in the title, given above. The work is illustrated by numerous diagrams and plates. The advanced electrician will here find detailed the methods by which the British Association units of electrical measurement, now used all over the world, were determined. The Cantor Lectures of Prof. Jenkin, which are appended, give a comprehensive scientific account of submarine telegraphy, and the methods of testing ocean cables.

A TREATISE ON ELECTRICITY AND MAGNETISM. By JAMES CLERK MAXWELL, F.R.S. Second Edition. In two volumes, 8vo, cloth, 20 plates and 105 illustrations. Oxford, 1881. $8.00.

CONTENTS.

On the Measurement of Quantities—Description of Phenomena—Elementary Mathematical Theory of Electricity—On Electrical Work and Energy in a System of Conductors—General Theorems—Mechanical Action between two Electrical Systems—Points and Lines of Equilibrium—Forms of Equipotential Surfaces and Lines of Flow—Simple Cases of Electrification—Spherical Harmonics—Confocal Surfaces of the Second Degree—Theory of Electric Images—Conjugate Functions in two Dimensions—Electrostatic Instruments—The Electric Current—Conduction and Resistance—Electromotive Force between Bodies in Contact—Electrolysis—Electrolytic Polarization—Mathematical Theory of the Distribution of Electric Currents—Conduction in three Dimensions—Resistance and Conductivity in three Dimensions—Conduction through Heterogeneous Media—Conduction in Dielectrics—Measurement of the Electric Resistance of Conductors—Electric Resistance of Substances—Elementary Theory of Magnetism—Magnetic Force and Magnetic Induction—Magnetic Solenoids and Shells—Induced Magnetization—Particular Problems in Magnetic Induction—Weber's Theory of Induced Magnetism—Magnetic Measurements—On Terrestrial Magnetism—Electromagnetic Force—Ampères Investigation of the Mutual Action of Electric Currents—On the Induction of Electric Currents—On the Induction of a Current on Itself—On the Equations of Motion of a Connected System—Dynamical Theory of Electro-Magnetism—Theory of Electric Currents—Exploration of the Field by Means of the Secondary Circuit—General Equations of the Electro-Magnetic Field—Dimensions of Electric Units—On Energy and Stress in the Electro-Magnetic Field—Current-Sheets—Parallel Currents—Electro-Magnetic Instruments—Electro-Magnetic Observations—Comparison of Coils—Electro-Magnetic Unit of Resistance—Comparison of the Electro-Static with the Electro-Magnetic Units—Electro-Magnetic Theory of Light—Magnetic Action of Light—Ferromagnetism and Diamagnetism Explained by Molecular Currents—Theories of Action at a Distance.

This work is one of the great classics on electricity. It was written as a complement to Faraday's "Experimental Researches," treating the subject from the mathematical point of view, as that work did from the physical. To understand it a thorough mathematical knowledge is essential. To the student of electricity who takes up the study from purely scientific interest, and desires to investigate the subject to the very bottom, Maxwell's great work is indispensable. No one who wishes to truthfully apply to himself the title "Electrician," in its highest sense, should rest until he has mastered this work, even if he should have to take up the study of the higher mathematics for that purpose.

MATHEMATICAL TREATISES.

AN ELEMENTARY TREATISE ON ELECTRICITY. By JAMES CLERK MAXWELL, F.R.S. Edited by WILLIAM GARNETT, M.A. 8vo, cloth, 6 plates and 54 figures in the text. Oxford, 1881. $2.00.

CONTENTS.

Electrification, Electromotive Force, Potential, etc.—On the Charges of Electrified Bodies—On Electrical Work and Energy—The Electric Field—Exploration of the Electric Field—Faraday's Law of Lines of Induction—Particular Cases of Electrification—Electrical Images—Capacity—Electric Current; Metals, Electrolytes, Dielectrics—Phenomena of an Electric Current which flows through Heterogenous Media—Methods of Maintaining an Electric Current—On the Measurement of Electric Resistance—On the Electric Resistance of Substances.

We have placed this work among the mathematical treatises because it contains a greater proportion of formulæ than those above mentioned; but there is very much in it to interest and instruct the non-mathematical reader. This is especially true of its definitions of the technical terms used by advanced electricians, which are so troublesome to the beginner. The work was left incomplete on the death of its distinguished author; fortunately, but little remained to be added, and this has been done in the spirit in which he wrote. The mathematical portion is nearly all confined to one chapter, which may be omitted by those who are not prepared for it.

AN INTRODUCTION TO THE THEORY OF ELECTRICITY. With Numerous Examples. By LINNÆUS CUMMING, M.A. Second Edition, with Corrections and Additions. 8vo, cloth, 100 diagrams. London, 1879. $3.00.

CONTENTS.

Physical Units—Theory of Potential—Application of Potential to Statical Electricity.—Problems in Statical Electricity—Theory of the Voltaic Cell—Ohm's Law—Problems in Voltaic Electricity—Magnetism—Absolute Dimensions of Physical Units—Problems in Magnetism.

The electrician who loves to set practice aside occasionally, in order to dwell on the science for its own sake, and the advanced student who wishes to master thoroughly every governing principle, both ought to have and use this interesting book. There are many students who desire to acquire a mathematical knowledge of the principles involved, in order to be able to reason about them and to analyze their capabilities more fully, and yet who cannot quite grasp the intricate equations of Clerk Maxwell. To such, this book will prove a great boon, because it accomplishes the same objects in another way. The author confines himself to geometrical methods of analysis, as being, in a manner, more tangible and comprehensible; and therein is a great improvement. We can follow this method of analysis more readily and grasp it more securely than by the use of the calculus. But even if it were only to serve as a stepping-stone to the more profound and exhaustive work of Clerk Maxwell, this book ought to prove of the utmost convenience and utility.

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Imitation Liquors.
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Weights and Measures.
The Metrical System.

The extent of this compilation, the care with which it has been edited and published, and the simple but thorough system of arrangement and index by which its contents are made available for use in practice, combine to render it a highly valuable book. We have examined it; the description and formulæ which it contains appear to be accurate and judiciously selected. The list of authorities quoted and consulted by Mr. Dick comprises the most eminent scientific periodicals of Europe and America, and goes far to guarantee the scientific value of his receipts. For the household, it is calculated to be a precious *vade mecum*; while the practitioner in any industrial art will find much in its pages of especial interest to him.—PROF. ROSSITER W. RAYMOND, in the *Engineering and Mining Journal*.

This work is one of the most valuable ever issued from the press. It embraces an immense variety of chemical and mechanical processes, the explanation of which is aided by a large number of engravings.—*Leffel's Illustrated Mechanical News.*

Mr. William B. Dick has been at the great pains of compiling, and Messrs. Dick and Fitzgerald have had the business enterprise to publish, an octavo of six hundred pages, entitled an "ENCYCLOPEDIA OF PRACTICAL RECEIPTS AND PROCESSES." It would be difficult to say what is not contained in this compilation in the way of domestic industry and household economy. We should think it might be almost invaluable as a companion, guide, philosopher, friend, and physician to the country gentleman. There is hardly an exigency in the daily routine of the family that we can imagine, in which it would not prove useful in its suggestions.—*New York Evening Post.*

In looking through the book one is amazed at the industry and investigation of the compiler. No department of science and art has escaped the vigilance of of this universal "receipter." If you are an honest man you can find in this ENCYCLOPEDIA what an honest man desires to know; if you are a scoundrel, all the methods of counterfeiting and adulterating are ingenuously exhibited.—*Boston Globe.*

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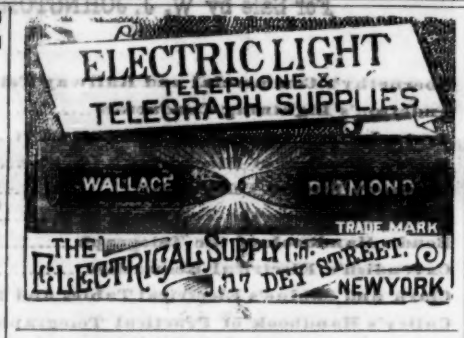

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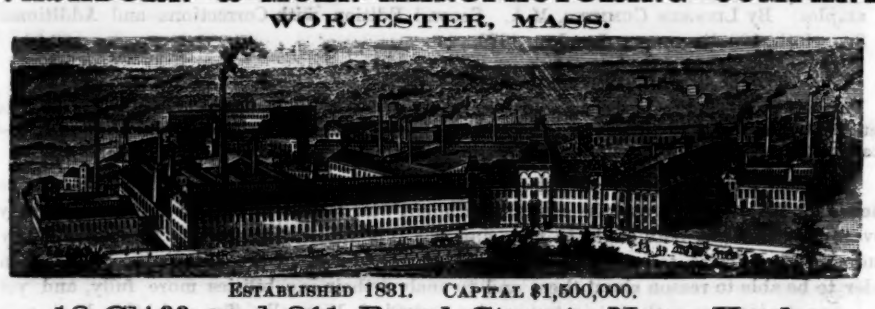

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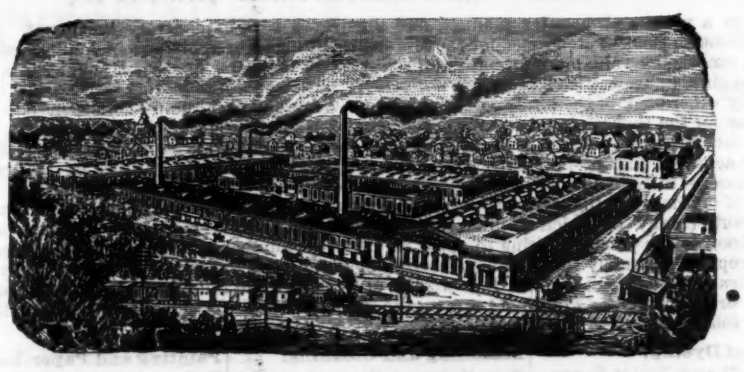

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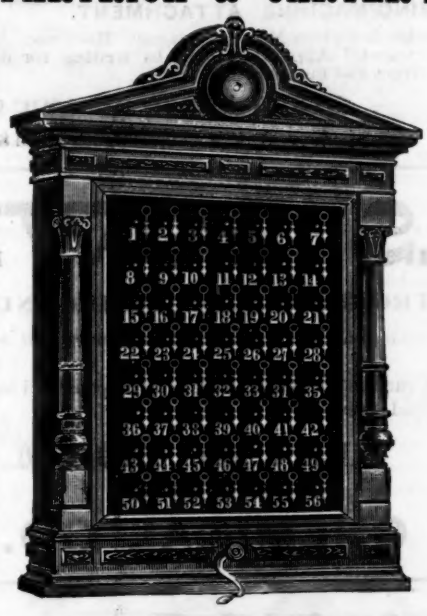

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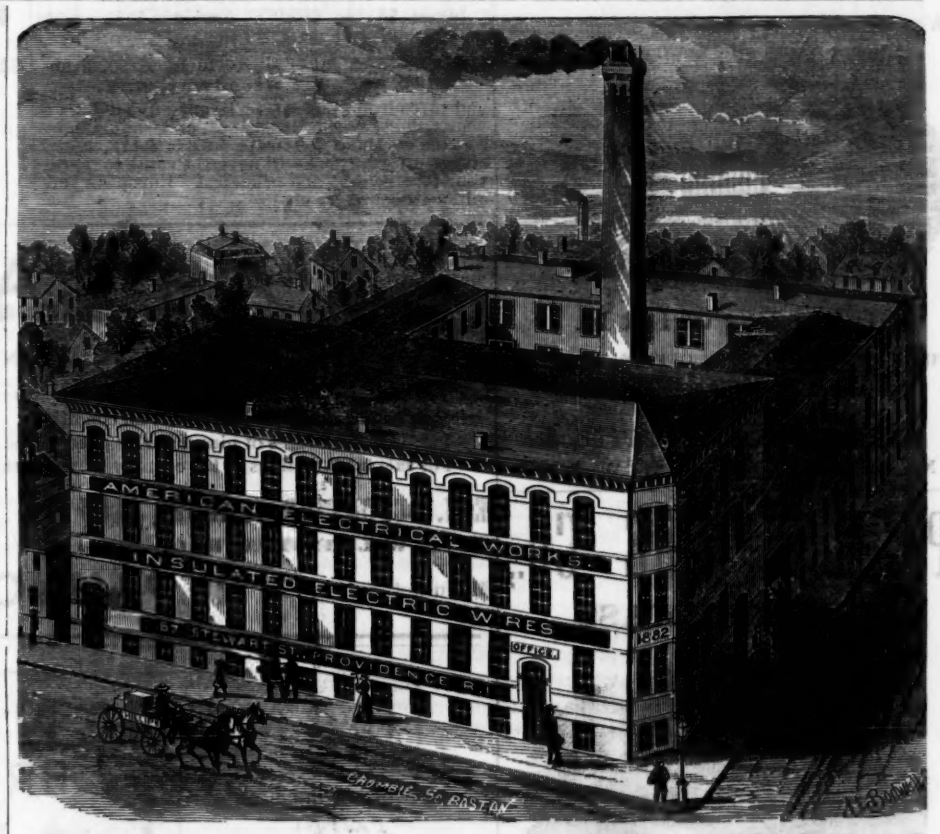

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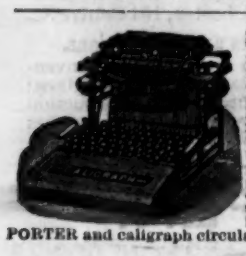

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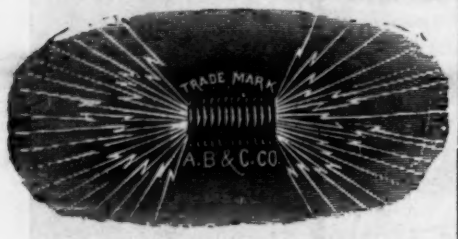

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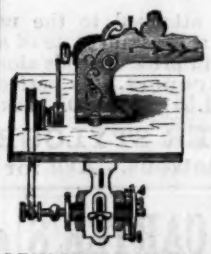

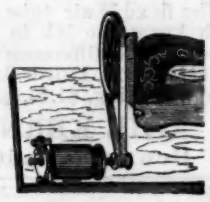

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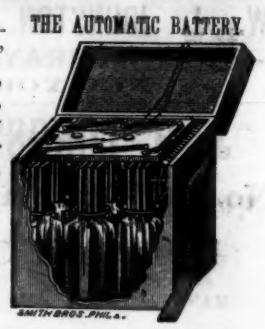

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